THE

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1901 Edition

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THE INTERIM REPORT ON NAVAL BOILERS.

THE presentation of the interim report of the Naval Boilers Committee has apparently come as a surprise to some people, and as a disappointment to others. For our own part we are, on the whole, fairly satisfied to find that the Belleville boiler has been strongly condemned. The Committee have, it is true, made an illogical report. While condemning the boiler, they do not advise that it be removed from ships in which it is already installed. The Committee pronounce in favour of the principle of water-tube boilers, because steam can be got up quickly in them—an argument of poor worth, especially in face of the fact that even now the particular water-tube boiler is still *in nubibus*. Thus we find that various other boilers are to be tried—the Dürr, Yarrow, Niclausse, the Babcock, &c. The authority consulted by the *Pall Mall Gazette* says that no committee of common-sense men could have come to any other conclusion than one condemnatory of the Belleville, but he is surprised at the retention of Bellevilles already fitted, though he calls this "tempering the wind to the shorn lamb of the Admiralty." The same authority further states his opinion that none of the boilers named will be found fit to do fair ocean steaming at designed speed without coming to grief, and "their continued experiment with water-tube boilers will be yet found to be as huge a blunder as the original institution of the Belleville." This is a point we do not care particularly to press. We certainly do not believe that any of the boilers named will be wholly satisfactory, for we expect they will smoke heavily, but we do not think they will prove so dangerous as the Belleville, though they may perhaps corrode as badly, if suitable means are not taken to prevent this. Like most reports of Parliamentary and kindred committees, this does not give full satisfaction. We, who have been alive to the particular danger and inefficiency of the Belleville boiler, think it probable that no such gigantic blunder will be repeated. At the same time we fully realise that some kind of water-tube boiler would be an advantage in regard to the putting of it in place without tearing open a ship's decks. But, until a really satisfactory type has been determined upon, we confess we should be glad to see the whole of our ships fitted with good cylindrical boilers of a design approved by a committee of mercantile engineers. We certainly place very little reliance on the greater safety of water-tube boilers against shot and shell. Indeed, we incline much to the reverse opinion, for, if a whole shell gets inside a boiler room, we think the type of boiler matters little, and if a shell gets through in fragments, the shell boiler is probably by far the safer type. In another column we reprint the report in full.

D

From this it will be seen that the first clause is very vague indeed, and the use of the word *provided* is very significant. Clause 2 is decidedly weak. Clause 3 is the illogical one which speaks for itself, and no doubt has been drawn up for reasons of expediency.

As regards Clause 4, we know, of course, that the Babcock boiler referred to is by no means the Babcock boiler so common in land work. It is very different, and consists of a steam drum, a front water leg and a back water leg, fed at the top, and the tubes are comparatively short and inclined somewhat steeply. As a slight recognition of the needs of combustion, the lower tubes are large and widely spaced, and the upper tubes are small and close together, but we see no hope of smokelessness in this boiler.

The Dürr boiler is somewhat similar in its tube length, but its tubes are double, of the Field type, and the front header is divided vertically into inlet and discharge partitions. This boiler also will smoke, but probably would not become over-heated if only the feed were admitted to the bottom of the flat tube chamber instead of at the top.

The Niclausse boiler is also of the Field tube type, fed at the top of the chamber instead of at the bottom, and is thus liable to some danger, as was recently experienced, we understand, in the Italian Navy. We fear there might be trouble with the jointing of the tubes in two plates at once. The Yarrow large tube type we have not before us. If of similar form to the small tube type, it would be possible to make provision for smokelessness, but we are unaware if this has even been attempted. Thus the boilers named do not seem to possess any special features, but Clauses 5 and 6 show that they are to be tried, and, if smoke counts, we feel sure a genuine trial will prove their present form to be impossible.

Clause 7 is, under heads (*a*) and (*c*), the most favourable to water-tube boilers. We should prefer to see the evidence in support of (*b*) before accepting it. This and other evidence appears to be forthcoming as per Clause 8.

In Clause 9 we come to the real gist of the report as regards the Belleville boiler itself, 11 special reasons being adduced against it, the majority of which are obvious and to be gathered from a drawing. In Clause 10 the Committee show their worst weakness, for they therein state their opinion that there was justification for adopting the Belleville boiler. We entirely fail to see how even the fact of its being the only boiler tried at sea up to the time named, can possibly be held as a justification of its adoption.

In Clauses 11 and 12 we find simply so much more condemnation, while in 13 we find that cylindrical boilers are advised for various auxiliary purposes. Do the Committee think that the auxiliary boilers will last so much longer than the water-tubes, that the question of cutting up decks may be neglected in their case? It would appear so. The whole class of water-tubes has suffered more from its friends than from its enemies, and we think it quite possible that a type of water-tube boiler may be found that will be correct enough in principle as regards water circulation and as regards smokelessness if only proper space be allowed. Touching the important item of corrosion, we believe there are marine engineers who hold that this can be prevented, and that there are in use in the mercantile marine appliances that will effect the purpose.

The report, such as it is, will put matters on a sounder basis. We ourselves would not longer pursue an aggressive tone in the matter. We care very little that this interim report is inconsistent in some clauses. Anyone can read between the lines sufficiently to explain such defects. Suffice it to say, that it finally condemns the gravest danger that has menaced our country for many a long year. We are not yet out of the wood, and we have no word as to what boiler is to be adopted pending the discovery of the satisfactory water-tube boiler. Here we might take a lesson from Uncle Sam, who, not having found the satisfactory one, has gone back—or forward—to cylinder boilers for his newest ships. It is a thousand pities our Admiralty did not do the same thing after they had fitted the *Terrible* and *Powerful* with Bellevilles, and await the result of those sufficiently costly experiments before going in wholesale for the French boiler at the cost of some millions of pounds.

The Belleville has been largely used in French warships and in the Mercantile Marine, and in some quarters the report of the Commission is attributed to jealousy on the part of English officials.

M. Marc Landry, the well-known naval expert, writing in the *Figaro*, says that the Belleville boilers have always given excellent results in French vessels, and he attributes the contrary experience in British ships to the fact that the authorities have always neglected to sufficiently initiate their engineering staff in the working of these boilers. He declares that it is not the boilers which require changing but those who have charge of them, and it remains to be seen whether by new trials the Admiralty will care to make the admission that British engineers did not know how to use a steam generator which elsewhere has been put to such good use.

The German Navy, on the other hand, says the Berlin correspondent of the *Standard*, has had the same experience with the Belleville boilers as the British Admiralty. It has only 18 such boilers on the *Hansa*, and 12 on the *Bertha*; but it will use no more, owing to their defects, especially the enormous consumption of coal they entail.

Rail Joints and Street Noises.—A correspondent of the *Scientific American*, at Bridgewater, Nova Scotia, has written to our contemporary regarding an article on rail joints and street noises, in which the use of the welded joint was suggested as the best means of getting rid of the loud pounding which seems to be inseparable from the present forms of spliced joints, and asks whether it would not be a better plan to provide a double rail, consisting of two lines of rails, laid side by side, so that the joint of one rail would always lie at the middle of the adjoining rail. The idea is not new, and has been tried, our exchange believes, on some European roads, where it was found that although the pounding was reduced, and the low-joint difficulty removed, there were so many attendant disadvantages, as to more than neutralise any benefits secured. The separate elements of a double rail must necessarily be bolted together, and the difficulty and labour of keeping the bolts tight is enormous. Our contemporary's recent suggestion that the elevated railways in New York would do well, in the reconstruction of their road, to introduce the welded joint, has been criticised on the ground that, except where such welded rails are embedded in concrete or Belgian blocks, it is impossible to preserve their alignment, because of the stresses which are set up by expansion and contraction under changes of temperature. The *Scientific American* is perfectly aware of the necessity for holding the rails in line during hot weather, but is of opinion that if screw-bolt connections instead of the inadequate railway spike were used on every tie, and if each tie were bolted to the stringers of the elevated structure, it would be quite possible to hold the rails in alignment even in the hottest summer weather. Such a construction would be costly in maintenance, and might not indeed commend itself to the shareholders; but it would bring relief to the citizens of New York from an inferno of din for which there is no parallel in any city of the world.

THE CARD SYSTEM APPLIED TO CENTRAL ELECTRIC SUPPLY STATIONS.

By F. W. FARRERWHITE.

The difficulty of keeping systematic records as the business of a central supply station increases, raises a question of practical interest as to whether books are really adapted to the needs of such an undertaking. The rapid accumulation of dead matter, and the consequent difficulty of reference, the impossibility of making additions to books with any semblance of method, are facts which have paved the way for the introduction of the card system patented by the Library Bureau, Limited; and experience has shown that the manifold advantages of this system of keeping records render it peculiarly applicable to the requirements of a central supply station. The following general outline of the method adopted at one of our central stations may, therefore, be of interest:—

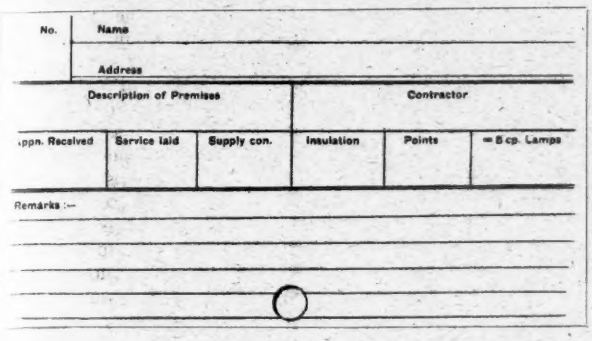


Fig. 1.

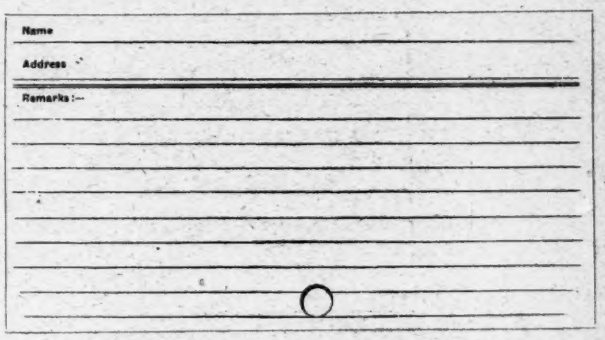


Fig. 2.

Consumers' Cards (about ⅔ size).

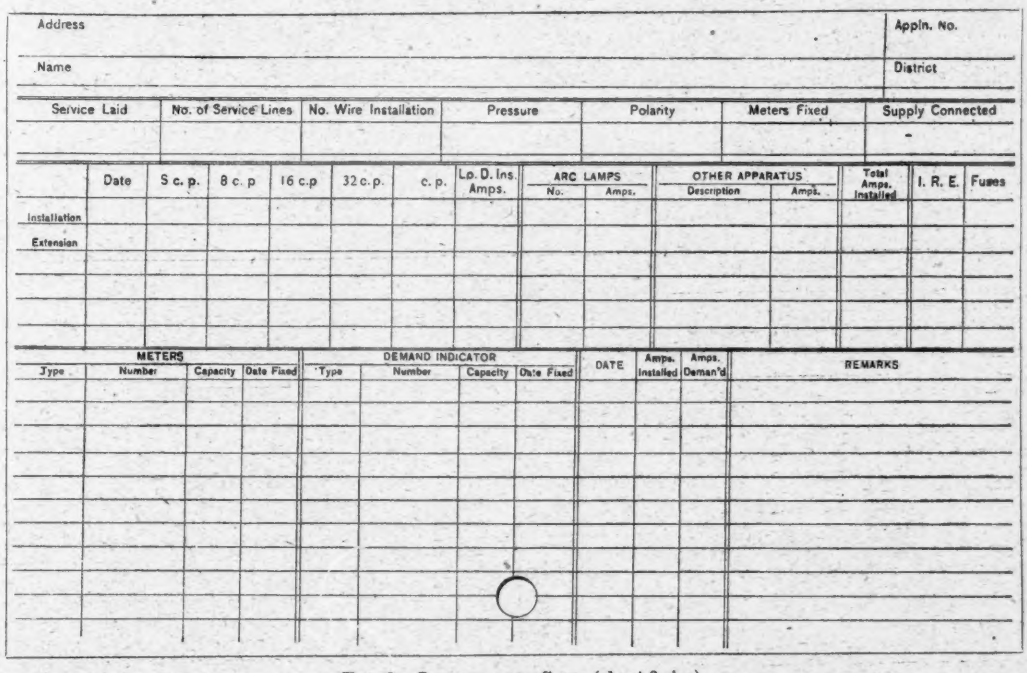


Fig. 3.—Installation Card (about ⅔ size).

(1)—The Consumers' Department.

In the consumers' department a set of cards has been substituted for the register of consumers. Each consumer has a card similar to fig. 1 allotted to him. It will be seen that in addition to all the standard information required concerning the consumer's installation embodied on this one card, a further space is reserved for information regarding extensions, references or deposits, and other kindred matter. This card is written as soon as a consumer has agreed to take a supply, and by means of two preliminary sections through which the card passes, it is possible to determine at once the exact progress of the work on any installation. This is effected in the following manner:—The card is first placed in Sec. 1 devoted to "Ready for Laying." On the service being laid it is then transferred to Sec. 2 known as "Ready for Connection." When the connection has been made the card is placed with the main set which is arranged in alphabetical order, each letter being divided by a guide card. Sections are also reserved for applications from intending consumers for whom it will be necessary to lay a supply main; and also for applicants who may be required to furnish a deposit. In the case of transfers a new card is written for the incoming tenant, and his predecessor's card is placed in a section retained for transfers.

In addition to the alphabetical set of cards just described, it will be necessary to have a record of consumers arranged in streets. A separate card, as shown in fig. 2, is therefore written for each consumer. The streets are arranged alphabetically, and are divided by guide cards bearing the name of the street. For the purpose of the collection of accounts the streets may be divided into districts indicated by guide cards of a different colour.

(2)—The Meter Department.

It is in the meter department, however, that the card system is more extensively employed and its advantages more fully appreciated. The following are some of the directions in which the card system may be utilised in this department.

(1) *Installation Card.*—For the purpose of keeping a record of the meters installed and a more detailed record

of the consumer's installation, a card similar to fig. 3 is utilised. In addition to giving particulars of the number of service lines, pressure, and polarity, columns are arranged to

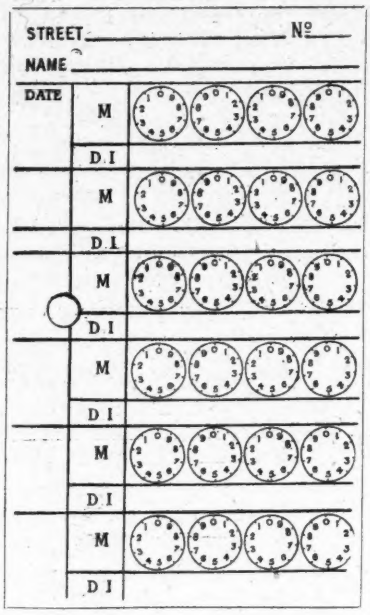


Fig. 4.—Meter Reading Card (about ¾ size).

record extensions of lamps of various candle-power or other apparatus, together with the installation test and fuses inserted at the time of connection. Spaces are also reserved for recording annually the maximum amperes demanded against the amperes installed, whereby unnotified extensions at once become apparent. The cards are arranged alphabetically in streets, each street being in numerical order. By this means an amount of information constantly referred to is recorded in an easily accessible form.

this object each consumer has a card (as in fig. 4) divided into six sections, each containing a space for the date, and four blank meter dials, on which the meter-reader sketches the exact position of the hands. Should demand indicators be used, a space may be reserved below each section for the reading of the instrument. Where readings are taken monthly, this card may be made to last 12 months, by having both sides printed. In addition to the fact that the liability to error is reduced to a minimum, the arrangement of the card presents another important feature. The set is divided into districts, and placed in the most convenient order for reading. Each meter-reader is responsible for the circuit allotted to him, no reader taking the same district two months in succession. By this means it is readily seen that owing to the expeditious manner in which the readings are taken, and the check which is thus effected on each reader's work, an important saving of time and labour is effected.

(3) *Ledger Account Cards.*—In spite of the prejudice shown to ledger cards by accountants, one similar to fig. 5 has been in use at a central station supplying over 3,000 consumers for the last three or four years, and has given complete satisfaction. The readings of the consumers' meters having been taken in the manner described are entered on this card, which is intended to replace the consumers' register. The card shown in the illustration is printed on both sides, each of which records the accounts for a complete year. The design of the card to be used for this purpose may, of course, be varied to suit the method of charging adopted. The set is arranged in streets numerically, and in this order may be conveniently used concurrently with the reading cards.

(To be continued.)

AMENDMENT OF THE PATENT LAW.

The report of the Committee appointed by the Board of Trade to inquire into the working of the Patents Acts, the substance of which was given in the *Times*, March 13th, contains recommendations of considerable importance to

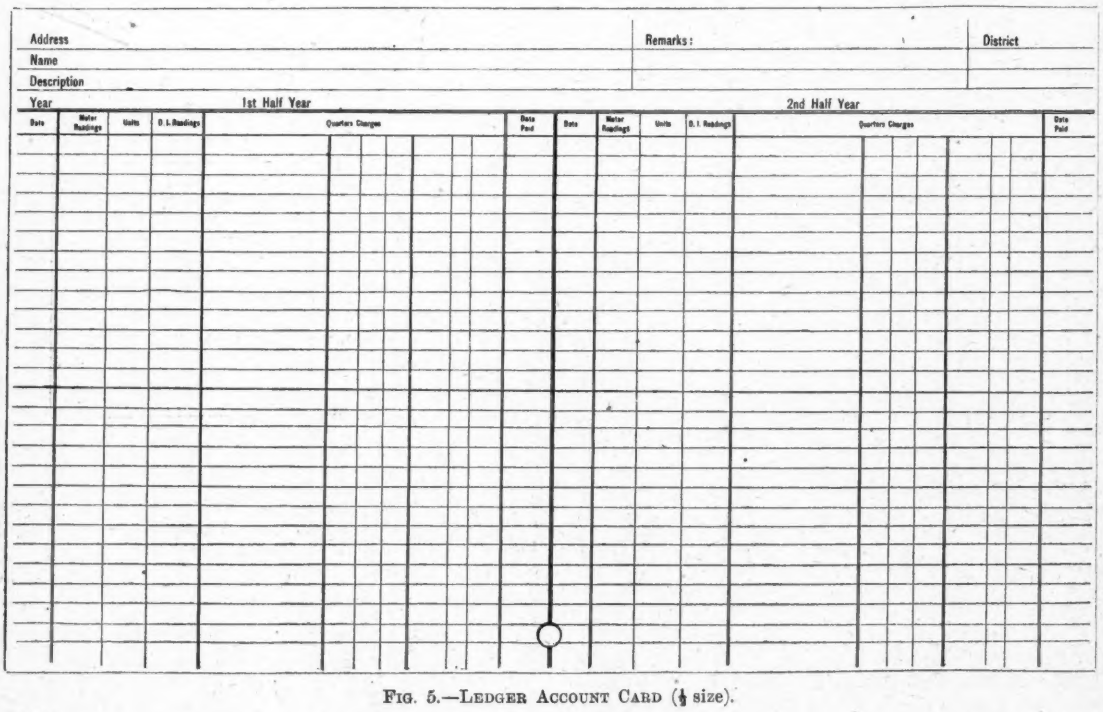


Fig. 5.—Ledger Account Card (¼ size).

(2) *Meter Reading Card.*—In order to facilitate the work of reading consumers' meters, it has been found necessary to devise some means whereby it is possible to obtain a *fac simile* of the position of the hands of the meters. To accomplish

inventors, to manufacturers and to the public generally. The questions on which the Committee were invited to express an opinion may be stated generally as:—whether the Patent Office should limit the issue of patents for inventions

which were obviously old, or had been previously patented in this country; the granting of compulsory licenses; and the extension of the seven months' priority granted to patents under the International Convention. The recommendations on the last two points may be summarised by saying that the Committee consider that the legal machinery for the granting of compulsory licenses should be made much more efficient, and that the period of seven months' priority should be extended to twelve months for foreign countries where there is a similar concession to British inventions.

The recommendations on the question of the limited examination of inventions for novelty are of a sufficiently modest nature, and yet go much further than the authorities in this country have hitherto proposed. The Committee interpreted "obviously old" inventions to mean "known in the industry but not previously protected." They have arrived at the conclusion that the number of these is relatively very small, and consequently they do not recommend any examination as to this class of inventions. But with regard to inventions previously protected by Letters Patent, they find that the case is entirely different, their number being very large both absolutely and relatively. The Committee proceed to say that the grant of invalid patents is a serious evil, inasmuch as it tends to the restraint of trade and to the embarrassment of honest traders and inventors. They therefore recommend that an examination should be made in the Patent Office into the question whether any invention claimed in a deposited specification has been claimed or described in any specifications of Letters Patent granted in the United Kingdom dated less than 50 years previous to the date of the application. The inquiry is not to extend to provisional specifications that have not been followed by a complete specification. As a consequence of this it will be necessary to enact that specifications of patents more than 50 years old shall not be considered an anticipation of an invention.

The changes in our Patent Law recommended by this Committee appear to be a step in the right direction. The conclusion of the Committee that the grant of invalid patents is a serious evil, must come as a surprise to those extreme advocates of our present *laissez faire* system, who maintain that little or no harm is done by the existence of such patents. The fact that the Committee has found that the number of such invalid patents is very large, disposes of the argument that the results of an official examination would not be worth the expense.

The Committee, however, though they recognise the evils arising from the granting of invalid patents, recommend much less drastic measures for the suppression of these fraudulent monopolies than those at present in force in the United States of America and Germany. In these countries the search is not limited to their own prior patents, but is extended to any publication. Even if the Committee's proposals become law, a patent might still be obtained, say, for some machine or process described in a book or technical journal, but not patented. We doubt if the number of invalid patents that might get in through this loophole is so small as to be negligible.

It is surprising that there has hitherto been in this country—the first country to abolish protection—so little agitation against so intensified a form of protection as illegal monopolies in the shape of invalid patents. The reason appears to be that the public, the purchasers of the fraudulently-protected articles, not feeling the tax because it is so widely distributed, have not organised any opposition, while the patent agents, who bitterly oppose any effective system of examination for novelty because their interests would suffer real or imagined injury, are well organised and sufficiently blatant.

MULTIPLEX WIRELESS TELEGRAPHY WITH TUNED APPARATUS.

(*Concluded from page* 440.)

To demonstrate the practicability of working multiplex with the apparatus described, the following experiments were tried. Two receiving instruments in the lecture room were connected with the lightning conductor fixed to the chimney of the electric central station at Schiffbauerdamm. According to the views which have hitherto obtained, this arrangement was the most unfavourable possible; and undoubtedly a large part of the incoming vibratory energy would be lost by conduction to earth through the chimney: but the small portion which acted on the point of the lightning conductor was quite sufficient for good signalling. Telegrams were despatched simultaneously from two different stations. One of these stations was in the laboratory of the Technical High School, Charlottenburg, about 4 km. distant. The transmitting wire was led out through the laboratory window, and up to the top of a mast 16 m. high fixed on the roof of the building. The window is on the west side, and the whole mass of the building consequently stands in the way of the rays. Only from the short length of the wire which projected above the roof, could electric waves be transmitted to the lecture room. The other station was at Schöneweide, 14 km. distant. The transmitting wire there was suspended between two chimneys, and the electric waves had to cross Berlin at its greatest width, encountering countless obstacles in the shape of chimneys, spires, &c., on the way. Perfect signals were obtained during simultaneous working at a speed of 72 letters per minute.

Since the lecture was delivered Prof. Slaby has given the following theoretical explanations of his system.

The theory of the transmitter leads to the following differential equation:—

$$W_1 \frac{d\,J}{d\,t} + L_1 \frac{d_2\,J}{d\,l^2} = \frac{1}{C_1} \cdot \frac{d_2\,J}{d\,x^2},$$

where W_1, L_1 and C_1 refer to unit length of the wire, and x denotes distance from its end. The solution gives the equations—

$$J = A\,e^{-\frac{W}{2L}t} \cdot \cos\frac{2\pi}{T}t \cdot \sin\frac{\pi}{2l}x$$

$$T = 4\sqrt{C\,L}$$

in which A is a constant, l the length of the wire, W, L and C are values which apply to the whole vibration path, and $\frac{1}{T}$ is the frequency of the electric vibrations. The expression $\sqrt{C\,L}$, if C is in electrostatic and L in electro-magnetic measure, gives the value of l in the case of long wires, and represents a wave-length $\lambda = 4\,l$. The potential difference for the unit length of wire is:—

$$\frac{d\,V}{d\,x} = B\,e^{-\frac{W}{2L}t} \cdot \cos\frac{2\pi}{T}t \cdot \cos\frac{\pi}{2l}x.$$

These formulæ show that the length of the waves generated is equal to four times the length of the wire, and that the alternations of potential in the wire follow a simple harmonic law.

The simple relation between wave-length and wire-length only holds good if the variation in the capacity of the wire caused by the proximity of the earth be neglected. Even

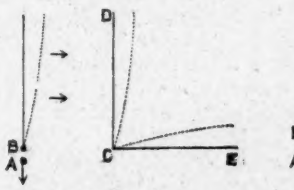


Fig. 3.

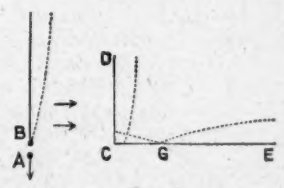


Fig. 4.

slight inclinations of the wire towards the earth produce a large variation in the capacity, and consequently a considerable increase of the wave-length. The earthing of the spark-gap is, for this reason, of immense importance in transmission.

If C D (fig. 3) represent a receiving wire earthed at C, the vibrations set up in it will follow the same harmonic law as the vibrations in the transmitting wire; if C D be extended horizontally by a wire of the same length a free node will be formed at C, and we shall have the same amplitude of

vibration at E as at D. Earthing the point C will make no difference.

If the receiving wire (fig. 4) is shorter than one-quarter of the length of the inducing wave, the amplitude at E will only be equal to that at D when the total length of wire, D C E, is equal to half the wave-length. A free node will be formed at G, the middle point of the whole wire. Putting C to earth does not materially decrease the amplitude at E.

If the receiving wire be in the form of a loop, as in fig. 5, D connected with H and the ends E and F free, perfectly similar vibrations are set up in C D and G H on the one side, and in C E and G F on the other, with nodes at C and G, and maximum amplitudes at D and H as well as at E and F. A spark micrometer inserted between E and F shows no difference of potential: these points, therefore, have no difference of phase. But if we join to E another piece of wire, E J (fig. 6), equal to half the wave-length, there will be

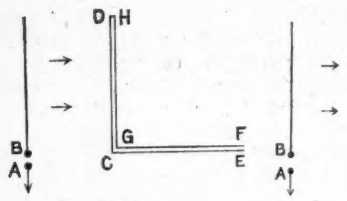


FIG. 5.

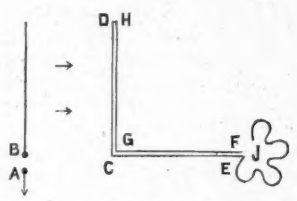


FIG. 6.

a change of phase of 180° between E and J. The spark micrometer inserted between J and F gives nearly twice as long a spark as when placed between F and the earth. The practical application of the results of these and numerous other experiments to wireless telegraphy is obvious.

That the connection of the lower end of the insulated receiving wire with the coherer must actually form a node at that point, follows from the fact that the coherer has, as measurements show, a capacity to earth of nearly 1 microfarad.

By the arrangement shown in fig. 6 double the tension is brought to bear directly on the coherer, and it is entirely cut off from the earth. Another great advantage is that the coherer is quite independent of the static charges of the atmosphere. Those who have had practical experience of wireless telegraphy know how frequent and troublesome are the disturbances caused by atmospheric electricity. The happy idea occurred to Count Arno during the lecture of simplifying the arrangement by using the simple wire D C E (fig. 6), instead of the double wire, and inserting the coherer between the point E and J. This has precisely the same effect. Signals were received with this apparatus without any earth connection, thus completely disproving the view still frequently expressed that the earth plays an essential part in the transmission. The action of the multiplier in increasing the potential difference was discovered by Prof. Slaby whilst attempting to give a more convenient shape to the auxiliary wire, E J (fig. 6), by making it into a coil. The extraordinary increase of tension which he observed led him to investigate more closely the dependence of this effect on the shape and number of the turns of wire. The theory of the multiplier is not quite clear. In Prof. Slaby's opinion its action is due to a retardation of current phase in the convolutions of the coil, of such a kind as to reverse the sign of the mutual induction in certain of the coils.

To the question of how far it is possible to work with the new apparatus, Prof. Slaby is at present unable to give a reply. His first care is to devise a system which can be worked continuously and safely by unskilled operators. The determination of the distance attainable will follow, the German naval authorities having already made arrangements to provide the warships necessary for the experiments.

Gisborne (N.Z.).—A firm of electrical engineers has been consulted as to the cost of lighting Gisborne by electricity, and has given an estimate that for an expenditure of between £12,000 and £15,000 the falls midway between Gisborne and Wairoa could be "harnessed," and a complete electric lighting system installed.

STREET LIGHTING FROM A GAS ENGINEER'S STANDPOINT.

THE presidential address by Mr. Corbett Woodall to the Southern District Association of Gas Managers on Thursday of last week, simply bristles with debatable questions and points which will, or would, if opportunity were afforded, raise the ire of many electrical engineers. This is naturally expected, but what is more important to our readers is the well merited criticism of an able engineer on purely technical questions connected with street lighting particularly, and the responsibility of municipal engineers for the advice given to local authorities as to the structures erected in metropolitan thoroughfares. When Mr. Woodall deals with gas *v.* electricity he is not always free from personal bias. This, we think, is excusable, but would be admitted by any impartial layman reading his address. Coming to more general matters, he is trenchant and terse, saying things which, if not altogether pleasant, are mainly true, and uttering words of warning which ought not to fall unheeded on the electrical section of the engineering profession to which most of our readers, in common with Mr. Woodall, belong.

Let us see how much there is in common between the gas and electrical engineer. What Mr. Woodall says respecting the nature of the influence which the rivalry of electric lighting enterprise has exerted upon the professional standing of men in his own profession is equally true as a statement of a reflex action upon our own. The increased need for a thorough preparation on the part of those who have begun to follow and hope to attain success, is common to both callings. To do any real good in either, a man must "have his heart in it, keep all contemporary knowledge concerning it at his fingers' ends, and find happiness in improving his practice in the smallest detail. This is the spirit to help a man through the tight places and over the rough spots in life." "Specialisation must not be attempted too early, and not at all unless the previous grounding has been sound and adequate. For the 'afterguard' of our gas"—and electricity works above all and beyond all—"we want well-educated lads, with the fibre of gentlemen, the sort that has plenty of pluck, is true to his salt, and will not tell a lie."

A career sustained under competitive conditions is never a bad one for those who are strong enough to bear the strain, yet Mr. Woodall has to lament the greater attraction to the best class of young men, whom he would like to see coming to the gas industry, of other branches of engineering, particularly the electrical branch, which has been choked with learners, while the lack of suitable assistance is one of the worries of many gas managers. The vogue of electrical enterprise is distinctly beneficial to the able and worthy gas engineer, for the two kinds of artificial lighting service are mutually helpful to their *personnel*, it being impossible for the electrical or gas engineer to be underpaid in the long run, while one or other is being well looked after. The records of municipal council meetings afford plenty of evidence to show that Mr. Woodall is right in this, as he also is when deploring the hard-and-fast distinction between the parties of capital and labour, which has been developed to a large extent by the trade unions. As this spirit grows promotion from the ranks must become scarcer, a change made, too, by those who might be presumed to have everything to gain and nothing to lose by the removal of all artificial disabilities to the freest play of native talent.

On public lighting Mr. Woodall speaks with no uncertain voice. It is the part of gas and electricity authorities to take the initiative and furnish those entrusted with public lighting with the opportunity and the requisite information for bringing the street lighting service up to date. He declares London to be the worst lit capital city in Europe; the lighting is a scandal, a reproach and a danger. "In spots the gas lighting is splendid," and we would add the electric lighting also *in parts* is equally splendid, although he prefers to talk of highways where all is muddle and artistic depravity, marked by electricity for its prey, when it would be truer to say that gas and electricity are severally allowed to show nothing of their capabilities where the local authorities refuse to take any interest in improved street lighting—*e.g.*, High Holborn.

Central roadway lighting is condemned, as it well might be, for we agree that the sidewalks are only too often put into relative darkness. When central lighting was adopted no experimental evidence of the nature of the effect to be expected was in existence, but in Paris and other places central lamps are always combined with side lamps. The arc lamp standards of the metropolis are characterised as the most hideous it is possible to imagine in a bad dream; and the crutches or brackets as monstrosities, not to be tolerated anywhere out of London. Regent Street has been, it is urged, condemned to the very worst method of lighting a street that could possibly have been chosen; that this stricture is based upon fact is evident to anyone who has walked down that thoroughfare late in the evening. It was once suggested that there might be a reason for this; we prefer to leave the matter an open question.

We admit that above the prevention of crime and the facilitation of the arrest of the criminal, is the cheering influence of good light, and plenty of it, on the moral and social sides of the people's life; that personal smartness, cleanliness of body and surroundings, good temper and harmless gaiety are promoted by ample public lighting, but we deny that it is unjust to the mass of ratepayers to string a few electric lamps sparsely along some chosen main thoroughfare, when the "stringing" is done with discretion, "the few and sparsely" are not too few and too sparsely, and the "chosen" thoroughfare has good claims to the most powerful and effective light known to us moderns. It is hardly too severe to say that it is also untrue to brand "the electric lamp" as "having been found wanting, as well as extravagantly costly, as a street illuminant all over the world." Liverpool, Edinburgh and Glasgow, to say nothing of the metropolis, could produce a wealth of opinion and practice to refute this rather dogmatic and sweeping assertion. Street lighting gives both gas and electrical engineers a good deal of trouble and anxiety, and is not, indeed, very profitable in itself, but in both cases it provides a certain means of advertisement which is not to be despised. Gloomy streets are not, it is correct to say, the fault of the gas companies, as the lighting may be improved without recourse to electricity; but if electricity be preferred, the ratepayers need not be put to "exorbitant cost," nor, in the majority of instances, is "electric lighting thoroughly unsatisfactory."

It will be seen that Mr. Woodall has committed himself to some opinions which, like most heresies, are exaggerated and perverted truths. Based upon just criticism of mistakes and ill-considered schemes laid to the charge of electrical engineers, he has erected a superstructure of condemnation which can hardly be justified in face of the obvious facts. Gas engineers are quite right in believing that they supply a commodity equally valuable to the public as electricity. To go on and say that gas is the ideal illuminant for street lighting is to strain and weaken their position. Notable is the omission to refer to interior lighting. The fact seems to be that electrical engineers sometimes overstate their own case, and would have gas companies shut up altogether, and it is not surprising that the rival faction carries on the friendly bout on similar lines. Still there is so much of real value in Mr. Woodall's address that we have, while thanking him for sincere criticism and some fresh ideas, to deplore the extremes to which he has allowed himself to be led in dealing with this one topic of street lighting by arc lamps touched on in his range of subjects, most of which are handled in such an impartial manner that electrical men as well as gas engineers would be, as he says, the gainers by giving them close attention.

THE SYNCHRONISING OF ALTERNATORS.

Of all central station apparatus, probably less advancement has been made in that appertaining to synchronising than in any other of the many instruments in daily use in a generating station. We are practically in the same position in this matter as we were years ago, with the exception that the voltmeter has very generally taken the place of the incandescent lamp as an indicator. The importance of good synchronising as opposed to the old haphazard style of throwing the switch in almost anywhere, and allowing the machines to pull themselves in, is daily becoming more recognised, especially in the larger stations, and when we consider the evil effect of perpetual bad synchronising on a machine in the way of racking the coils and of setting up undue electrical strains in the armature, it is only right that it should be so.

Because very little progress has been made in synchronising methods, it cannot be argued that the present system is perfectly satisfactory, although of the few that have been tried it is certainly the best.

Synchronising as it is now performed leaves too much to the skill of the operator; indeed, everything depends upon it. A nervous or unskilled man may cause hundreds of pounds' worth of damage by being a second or two late with his shot. This is especially likely to occur in a breakdown, where, perhaps, the machines that are running are heavily overloaded, owing to the sudden failure of one or more of the others.

Under these conditions, synchronising with the present apparatus is an extremely difficult operation to perform, and calls for the greatest coolness and skill on the part of all concerned. Alternators that are heavily overloaded will sometimes tend to come out of step, which of course is due to the engine, and not to the alternator; the result of this is that the phases shown on the sychronising voltmeter become very erratic and unreliable, and often necessitate what is known among central station engineers as a "flying shot."

This is always a more or less risky proceeding, but with the present system it is the only one possible in a breakdown.

The writer cannot offer any suggestions for what must needs be a very radical improvement in synchronising methods, but feels that some of our master minds might with profit devote a little attention to this somewhat neglected point. In a breakdown of the above type it is very usual for the voltage to fall so low that the synchronising voltmeter becomes useless, owing to its frequently not being designed to read accurately below 75 volts or thereabout. In central stations fitted with this type of synchronising voltmeter, recourse must be had to the engine driver's pilot lamp, which under these conditions can be of but very little value, owing to its never reaching more than a red glow. To meet this emergency at some stations, in addition to the usual synchronising voltmeter, a low reading voltmeter has been fitted to the switchboard and used for synchronising at low volts. It is, of course, quite possible to use a voltmeter that reads over a wide range, but instruments of this type are never so dead beat or so generally satisfactory as those designed to read only on that part of the scale where they are presumably to be used. The old style of synchronising by an incandescent lamp was extremely unsatisfactory, owing to the great lag of the light behind the voltage, and to the uncertainty as to when the lamp was at its maximum brightness. On account of this latter defect it was never possible to guard against what may be termed a "short phase," that is to say, a phase where the secondary voltage of the synchronising transformer does not rise to its maximum, but after nearly reaching it, suddenly falls back to zero. Short phases are of common occurrence in synchronising, and when using a lamp only it is practically impossible to tell them from good ones; as after the lamp has been flickering up and down for a minute or two the eye cannot discern the difference occasioned by four or five volts. All central station engineers know that short phases are things to be avoided; switching in on one is at the best bound to result in a very bad shot and may, unless the machines are designed to pull in, easily cause more or less damage. A voltmeter is greatly superior to a lamp in this case, but in the negotiation of a short phase it still leaves much to be desired.

The fault of lagging is not only confined to the lamp; the best voltmeter has it, although in a modified degree. The lag in a voltmeter is, of course, caused by the inertia of the moving parts and also by the damping arrangement. In a quick phase the inertia tells by causing the voltmeter to kick, and to momentarily show in some cases a much higher voltage than is across its terminals. This, however, is not of any importance, as a quick phase should never be taken except in emergency.

With the ordinary slow phase, the inertia causes no kick,

and the only thing left to experience is to know how much to allow for the lag of the instrument. This, of course, is a variable quantity, depending entirely on the speed of the phase; the quicker it is, the more must be allowed, and *vice versâ*. Some engineers prefer what may be termed a "standing phase," that is to say, one where the synchronising voltmeter needle rises to the maximum and stops there for several seconds. While phases of this type should be theoretically perfect, they are often in practice found to be anything but desirable.

There is always an element of uncertainty about them; if they slowly move a volt or two down and then come up again they may be taken with safety, but when the needle stands still with perhaps a tiny quiver they are risky, as the phase may be going back, although the inertia of the moving parts keeps the needle momentarily at the maximum. The result of closing the switch too late is always worse than that of closing it too early. Rather be early than late is as sound a maxim in synchronising as in everything else. The reason is, that in an early shot the electrical action set up between the machines on the closing of the switch acts in the same direction as the engine which is bringing them into phase; but in a late shot the action is opposed to that of the engine, the motoring current between the machines tends to pull them back into step while the engine is doing its best to pull them out, as is seen by the fact of the synchronising voltmeter needle going back.

Hot-wire voltmeters are, of course, the best to use for synchronising; their inertia is small and there is not much need for damping, they have possibly more lag than an electro-magnetic instrument, but the latter is apt to be so violent in its action that its indications are not always reliable. One of the best synchronisers is that made by Messrs. Ferranti and fitted to all their switchboards. In their latest type they connect a couple of low candle-power incandescent lamps in parallel with the synchronising voltmeter and place them underneath it, and this has the effect of greatly helping the eye to determine the correct moment for closing the switch. The voltmeter used is of the Hartmann and Braun hot-wire type and is very satisfactory.

When lamps alone are used for synchronising, it is useful to remember that the lower the candle-power the better the result. The lag of the light behind the voltage increases with the candle-power of the lamp, owing to the thicker filament taking longer to attain incandescence. Two-phase alternators are synchronised in the same manner as single phase. The incoming machine is synchronised on one phase, and the linked switches of the two-phases then thrown in together. Of course, they could be thrown in separately, as if one phase is in synchronism with the bus bars, so must the other one be, as they are rigidly connected in the machine, and therefore bound to keep the same phase difference. It is better, however, to switch in both phases at once, as, if the shot is not all that it might be, the machines will pull into step much easier with both halves of the armature helping than they would with one alone. The link on two-phase machine switches should, however, be removable, so that if the machine fuse on one phase should blow, it would not be necessary to open both switches to replace the one fuse.

RAW-HIDE GEAR WHEELS.

The increasing use of electric motors for power purposes has already necessitated the evolution of new forms of gearing, in order to eliminate first, noise, and secondly, undue wear and tear of the various parts; and in the case of machinery driven under undue atmospheric conditions, or in wet situations, such as pumping machinery, a material is required which will withstand moisture, and at the same time possess durability and noiselessness. These demands have been met by various forms of raw-hide gearing, which is now occupying the attention of many manufacturers, both in this country and in the United States. One of these firms, the Buffoline Noiseless Gear Company, Levenshulme, Manchester, send us some interesting details relating to their manufacture. Their gears are now being used for motors, pumps, cranes, printing and textile machinery, motor cars, and similar applications. The raw-hide prepared by a special process is built up, compressed and turned to suitably sized blanks, and is then cut to either diametral or circular pitch, as may be ordered, diametral pitch being recommended as saving calculation and tending to standardisation. The "involute" form of tooth is adopted as the standard, although other shapes can always be supplied. The illustration (fig. 1) shows a segment of an eight "diametral" pitch wheel. The wheel has 24 teeth, and is 3-in. pitch diameter, giving eight teeth to each inch of pitch diameter reckoned as eight diametral pitch. The small illustrations show a small pinion, brass bushed, and steel shrouded (fig. 2), and a pinion with teeth cut through (fig. 3), the latter being used when there is not sufficient room for the shrouds to come over the teeth, or when the pinion runs as an idler, and has no keyway. We also show an electrically-driven pump, where the gearing is of the Buffoline Company's manufacture. They claim that wheels can be manufactured up to any diameter, but we fancy from the nature of the material that this is such as would render it inadvisable to use raw-hide for very large gear-wheels.

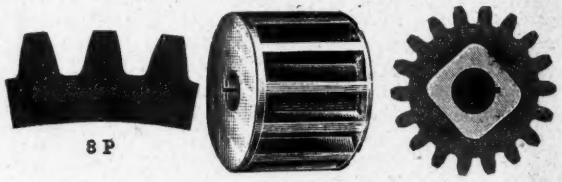


Fig. 1. Fig. 2. Fig. 3.

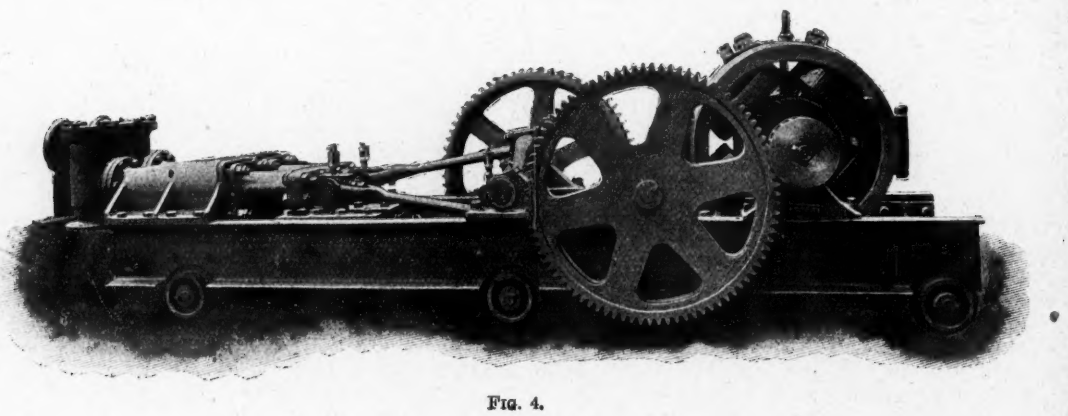


Fig. 4.

DINNER OF THE INSTITUTION OF JUNIOR ENGINEERS.

On Saturday evening last the 16th anniversary dinner of this Institution took place at the Westminster Palace Hotel. In the absence of the president, Sir Lowthian Bell, and of Sir E. J. Reed, Prof. Perry occupied the chair. Covers were laid for about 125 guests. At the conclusion of the repast, after the loyal toasts had been duly honoured, Sir J. Jackson proposed "Our South African Field Forces," and foretold a happy issue out of the racial conflict when the Boers discovered, by trial, what good Government really is.

In reply, Sir David Tennant, Agent-General for the Cape Colony, paid graceful tributes to the sister colonies, and to the mother country, for their free expenditure of blood and treasure for the sake of South Africa.

Proposing "British Engineering," Sir W. Preece made fun about

his promotion, the programme giving him the title of Agent-General not only for Natal, but also for the Transvaal and Orange River Colonies—which, as he said, want nothing so much as *peace!* Discussing the subject of the toast, Sir W. Peace laid stress on the absence of a central authority to fix and to maintain a standard of quality for iron and steel, as Lloyd's, for example, does for ships. Foreign competition, to his knowledge, grows keener every month, and every effort must be made to maintain our position.

Prof. Perry, acknowledging the toast, said that the National Physical Laboratory would supply the standardisation demanded by Sir W. Peace. We had the advantage of seven centuries of freedom, while our Continental rivals escaped from serfdom barely a century ago. What is most wanted is to educate our capitalists, and to induce them to trust engineers to know their own business.

Mr. Walter Hunter also replied to the toast.

The "Commonwealth of Australia" was next proposed in felicitous terms by Mr. E. King (vice-chairman), and acknowledged by Sir Horace Tozer in an eloquent speech, glowing with patriotism and fervent optimism. Sir Horace stated that Queensland, for which colony he is Agent-General, had not spent a farthing out of England for engineering materials, while he had sent out numbers of young British engineers with most satisfactory results. The speaker concluded with a description of the growth of Australian unity and of the intensity of Australia's attachment to the old country, which brought down the house, and the choral honours accorded to Sir Horace were well earned.

The Hon. W. P. Reeves, Agent-General for New Zealand, proposed the "I.J.E." in a speech full of wit and humour. Mr. Reeves believes in the British engineer and in the British workman, and attributes the troubles of British trade to over-capitalisation; the financier, company promoter and jobber have too much to say in the matter.

In reply, Mr. Percival Marshall, Chairman of the Institution, dwelt briefly on the progress of the Junior Engineers, and afterwards toasted Prof. Perry and Sir Lowthian Bell. Prof. Perry, who was declared to be a "jolly good fellow," suitably replied, and the formal proceedings came to an end. The musical programme, however, under the direction of Mr. W. J. Tennant, which had been interleaved between the toasts, continued for some time longer. Messrs. Meyer, Rugg, Goodes, and Sid Carter sang, Messrs. Blackmore and Moore performed on the piano, Mr. T. E. Gatehouse fiddled, and Mr. H. A. Clift whistled, to the hearty satisfaction of the audience.

CORRESPONDENCE.

Aluminium Mains in Practice.

We hope you will allow us to make a few remarks upon an article marked "Communicated," which appeared in the March 8th issue of your valuable paper. The article is entitled "Aluminium Mains in Practice," and refers to one installation only, viz., that at Northallerton.

As aluminium has been used as an electrical conductor for a number of years now, and on a large scale, and as there are hundreds of aluminium overhead lines at this present moment working perfectly satisfactorily, it appears to us rather extraordinary that your anonymous correspondent should deduce freely general conclusions from the experience of only one installation, about which, moreover, he cannot have a very intimate knowledge, as he does not even know the exact diameter of the wires used; in fact, he mentions that all aluminium wires are $\frac{3}{4}$-in. in diameter, whereas the wires used at Northallerton were of three different diameters, viz., ·33 in., ·468 in., and ·662 in. (the latter being the largest).

It is also to be regretted that your correspondent should not have given his name, as we should then know what reliance could be placed on the figures he gives for the conductivity of the wires, and for the analyses of the aluminium used. We may state that all aluminium sold by this company as pure contains over 98·5 per cent. of aluminium, and when we know that the metal is going to be used for electrical conductors, we make a point of delivering nothing below 99 per cent. purity. Our chemist having naturally a great experience in making analyses of aluminium, we believe that our figures are thoroughly reliable.

As regards conductivity, a great many tests have been made during the last few years, some of which have been made by Lord Kelvin, and they all concur in stating that aluminium of over 99·6 per cent. purity shows a conductivity of nearly 64 to 65 per cent., taking copper at 100 per cent. Aluminium of about 99 per cent. purity shows a little less conductivity, amounting to 60 to 62 per cent. of that of copper. We cannot, therefore, reconcile these figures with the figure of 51 per cent. given by your anonymous correspondent.

With reference to the troubles which he states have been experienced at Northallerton, we can only refer to an article published in the *Electrician* on October 26th last, on the subject of the same installation at Northallerton, in which we read that, up to that date, aluminium conductors had been a great success, that so far no trouble whatever had arisen, and that although the wires were originally intended to take only a maximum current of 100 amperes, they were nightly loaded with 250 amperes without any ill effect.

In this same note, dated last October, it is mentioned that brass-socketed joints, which had been "put up in the first place merely as a 'make-shift,'" were still standing, and "had not given way in one single instance."

It goes without saying that if joints are made of aluminium and copper or aluminium and brass, especially if they are very much exposed, they cannot possibly stand very long, as galvanic action is bound to set in; if, therefore, brass-socketed joints have been used for long with aluminium wires, it is not to be wondered at that bad results have been obtained. We think it is very much to be regretted that the engineer in charge of this installation did not at once do away with these brass-socketed joints, and use nothing else but aluminium, and if he had done so, we are sure that the aluminium would have given complete satisfaction, as it has done in a great many transmission lines which now exist, and which are carrying electricity to a great distance.

We may mention that we have ourselves several aluminium transmission lines, which have been in use for several years, and we have had no trouble at all with them, nor had to make any repairs; and to corroborate this fact, we are perfectly willing to show these lines to anyone interested in the subject.

We should like just to add one more word about the statement made by your correspondent, which appears to be very vague, as regards the cost of aluminium. Aluminium can be worked and used exactly in the same way, and with the same facility as copper, therefore we cannot see any reason why it should cost 10 per cent. more, as estimated by him. Aluminium conductors are now cheaper, and of only half the weight of copper ones, so that economy is realised, not only in the prime cost of the material, but also in the freight of same, which, at times, may form a large portion of the expense of a new installation.

In conclusion, we may state from the experience acquired by ourselves, as well as by our friends abroad, that aluminium is now being used more and more every day for electrical purposes, and we see no reason why aluminium conductors should not be utilised very extensively, in the near future, with great advantage.

For **The British Aluminium Company, Limited.**
E. Ristori, *Managing Director.*

Your "anonymous correspondent" begs to state that he does not deduce freely general conclusions from one installation, but that he deduces general conclusions and facts from various English and American engineers, and to make sure of the facts, he conducted tests and further observations upon one installation which has been working for some time. He also begs to state that he knows exactly the sizes of wires used, and that $\frac{3}{4}$ of an inch is as near to the actual as your correspondent's figure to the third place of decimals, and this size of wire was the particular stretch under observation. Again, what relation has an engineer's name to the conductivity of material? It is sufficient to say that the tests have been carried out by competent engineers, and the results agree with observations taken by others at a distance, and it may be safely said that figures on paper, at times, do not coincide with figures obtained under actual practice and experiment. It seems evident that the wires were only intended for 100 amperes, and that last year nothing like 250 amperes was passed through the wires, as the plant in the station was only capable of generating 180 amperes.

Why the engineer in charge used brass in place of aluminium, I cannot say; perhaps he had a stock of brass rod on hand that he wanted to get rid of. In the article upon

aluminium mains, aluminium as distribution mains was dealt with, not aluminium as transmission lines. There is a vast difference between the two in actual practice. It is evident that aluminium is cheaper than copper in the first instance, but that the total expense of the installation including up-keep, &c., after a given period is greater than copper when used as a system of distribution mains.

"Communicated."

Electrically-Driven Machine Tools.

In regard to the article published in the Review, March 15th, drawing attention to the short paper recently read by me on the above subject before the Newcastle Section of the I.E.E., will you permit me to make the following remarks?

Your critic has either misunderstood me on one or two points or not read the paper carefully enough. In the case of the three-motor *versus* one-motor cranes, it was distinctly stated in the paper "that in the case of installing *new* cranes, probably the three-motor type is advisable." In the case of adapting *existing* cranes to electric driving, I am certainly of opinion that the one-motor method is the simpler.

As regards separate driving and grouped driving, he agrees that for *large* machines the separate motor is better: it then becomes a question of what is a large machine, or, in other words, what is the smallest size of motor it is desirable to employ? This is, of course, a matter of opinion, and doubtless varies considerably for various classes of works and with different conditions of working.

My remarks as to the loss of power in shafting, &c., are fully borne out by the statements in papers on the same subject recently read by Prof. Benjamin (Am. Inst. Mech. Eng.), Mr. Esson (Civil and Mech. Eng. Soc.), Mr. Geipel (Gloucester Eng. Soc.), and Mr. Amos (London Assoc. Foremen Engineers and Draughtsmen).

No doubt these losses can be reduced by special devices and attention, but *average workshop* conditions were quoted.

My remarks as to the economy of electric driving when overtime, &c., is necessary are, of course, applicable to both separate and grouped driving, and there is nothing in the paper, so far as I am aware, which would lead one to conclude that I am not fully alive to the fact. An extreme case of only two machines being required to run was mentioned merely as an instance of the economy over the old method of driving the whole of the shafting in the shops from the main engine.

Geo. Ralph.

Newcastle-on-Tyne, *March 18th*.

Storage Batteries for Accumulator Traction.

Referring to Mr. Grindle's letter in the Electrical Review of March 15th, I am satisfied that the result of my article has been to arouse a discussion on this important subject. My only objection to boosters is the multiplication of machinery that they involve, and, while I fully appreciate the value of a constant voltage in the line, I think this is apt to be overrated, for we know perfectly well in practice that there is a good deal of car running at voltages less than half that at the station switchboard. I quite appreciate, however, the function of a booster which is to boost.

I notice that Mr. Grindle does not agree to the 6 KW. you state as nearer the actual consumption than his own 7½ KW. A careful series of determinations made by myself go to show that over a wide range of English practice in systems using four-wheeled cars, in the main there is no case in which the kilowatts attain 7½ per car, and the number of kilowatts in two cases where there were also large double truck cars at work is respectively 4·71 and 6·04, the average speed of the cars in the two cases being 4·7 and 5·4 miles per hour, both systems including severe gradients, and one at least suffering from such a temporary insufficiency of conductor area as seriously to reduce the line voltage. It is, of course, difficult to get the necessary statistics together to show these figures. All the figures are present in that mine of information locked up unconsidered in the office of the traffic manager, but no reliable information can be secured unless the traffic manager will dig out the figures of the hours run by each car over a given period, so that the total car-hours can be known.

There is a curious uniformity in all stations of current consumption per car-mile. Car-mileage figures are vouchsafed by managers, but half the value of tramway statistics is destroyed for lack of the car-hours, whereby alone, in conjunction with the car miles, we can ascertain the average car speed, the units per car-hour, and the usage factor of cars. It is only by such data that we can really know how to manage a tramway with economy. Actual practice shows that the average speed of cars may be double on one system over what is secured on another, and I feel sure, if Mr. Grindle will investigate the statistics of four-wheeled cars, he will find that ordinary English practice does not demand over 6 units per car.

W. H. Booth.

March 16th, 1901.

The Electrical Trades Union.

In thanking you for the insertion of my letter and your comments upon my experience, which, as you say, is limited (it is limited to 14 years of practical work in the trade), I would wish to point out that the fact of the "installation laid out in the office" (except in the particular cases I excepted) being a novelty to us, is to the average observer rather tending to prove that my fellow members, or perhaps I had better say the majority of them, are deemed by employers capable of doing their own laying out.

At any rate, that has been my personal experience, and far from never having worked to plans, which most usually are only for showing the position of lights, I have even been trusted with the preparation of them.

I will admit I was injudicious enough to send a letter without a string of self-considered qualifications, but had I done so I should have certainly expected to see it headed ADVT. and to have paid for its insertion.

I am pleased to note that you do not refute my statements as to the proposed rules having been accepted by most London employers for some considerable time.

J. P.

Still a Member of the E.T.U.

Northwich, *March 3rd*, 1901.

The experience of the majority of thoroughly-trained electricians whom I have come in contact with during over 13 years' experience, both as a wireman and as manager, has been the same as my own.

I have been asked more than once to join the E.T.U., but upon making inquiries I was told that so-and-so was a full member.

A man that I knew did not know how to wire for a single drop pendant and switch six months before he was made a member of the Union. As for working out plans, he (and many other members that I know) could not have done it. In fact, I very much doubt whether they had ever seen a plan at all.

How can the Union expect men who have had a thorough training to join a society which allows members of this stamp? They only bring the name of electrician into ridicule.

I have been told that anyone can become an electrician, and have answered that anyone calling themselves "electrician" does not prove that they are what they say. The sooner that the Union officials stop allowing any man who applies and says that he is an electrician without *giving* any proof that he is one, the better. They are only keeping the best men out of the Union by acting in the way that they are.

Manager.

Newcastle, *March 18th*.

As secretary of the Manchester and Salford Branch of the Electrical Trades Union, may I be permitted to reply to the letter in your last issue signed "J. Johnson Wood," and to give the facts of the case, which scarcely accord with Mr.

Wood's statements? He was admitted to this branch on December 21st, 1895, as an improver wireman, and continued to pay portions of the contributions due from him until June 6th, 1896, being excluded for arrears of contributions on September 26th, 1896. He says in his letter that he "left the clubroom in disgust one Saturday night; two accumulator jar washers-out made application for membership and were accepted." The only persons to whom this can possibly apply were two men who secured admission on the false representations of their proposers and seconders, and we, having no knowledge of the men, could only decide on the evidence before us, and they were afterwards dealt with as they deserved. The first of these two men was admitted on December 7th, 1895, a fortnight before Mr. Wood, and the other on December 21st, 1895, the same night as Mr. Wood. On which night did he leave the room in disgust? Further, having regard to the above dates, if he left the room (and as he infers the Union) in disgust, why did he continue to pay contributions at intervals extending over the following six months? I have the books in use at that date before me, as authority for dates, &c. Further again, why does he date his letter to you from a false address? I went to call upon him at Broadway, Salford, yesterday (Sunday) morning, and found he had removed from there as long ago as before last Christmas, and lives now in Hulme, from 2 to 2½ miles from Broadway. I can give his address, if necessary. Then again, he "knows that 6½d. per hour is an enormous salary round Manchester district." Well, the magnificent honorarium of 6½d. per hour, may be so to his mind, but to apply such a sweeping statement to the Manchester district generally is simply a *gross libel upon the employers* of the district. There may be some who expect to get competent skilled workmen for labourers' wages, but they are very few, and the Manchester electrical employers *are, as a class, as fair and as just to their workmen as any in the United Kingdom or out of it*, and the wages paid in the district for armature winders, wiremen, and jointers range from 8½d. to 9½d. per hour, and we have men in our branch getting £2 10s. per week, and even more, as standing wages. He also opines "that 95 out of every 100 wiremen are scrap." Let us see the value of that opinion. He first entered the wiring trade in May, 1894, in which month I showed him how to fix and connect his first ceiling rose, so that his experience is as yet short of seven years. Mine exceeds 20 years, and amongst the 134 members of this branch I can find quite 20 (winders and wiremen) of 15 to 20 years' experience, 50 more of from 7 to 15 years' experience, and the remainder are principally young men, who have served their time as winders, wiremen, instrument makers, &c. Mr. Wood says there is no Electrical Trades Union worthy of the name. What does he know of the Union of the present day, seeing it is nearly five years since his name was removed from our books?

A. Rogers,
Manchester and Salford Branch of the Electrical Trades Union.

P.S.—Please note that this letter is capable of proof by documentary evidence and reliable witnesses.

Your correspondent, "Formerly a Wireman," in your issue of March 15th, says he knows several men who gained admission to the E.T.U. as wiremen, who at the time of joining had not more than a few months' experience; granted that they had joined in violation of the rules which exclude men from joining as wiremen who have been less than three years in the trade, would their exclusion prevent them from imposing on employers as they had previous to seeking admission? When an employer pays the standard wage, the E.T.U. takes it as evidence that the man is competent.

In the main the responsibility lies with the ironmongers, decorators, and small builders, who suddenly blossom out as electrical engineers, and are indifferent as to the quality of work turned out, provided it is cheap and passes the insulation test of the supply company.

The remedy is that instead of the insurance companies sending a man whose inspection is often a farce, they should appoint a body of competent men to supervise all work while in progress, and condemn that which is not up to the standard; this is done with success by the American insurance companies. It would secure a better state of things for the contractor, the wireman who takes an interest in his work, and the most interested of all, the customer who has to pay.

J. M.

Peckham, S.E.

The Electrical Trades Union and its Late Secretary.

I am directed by my committee to contradict the statement appearing in the Review of to-day's date under the heading "Embezzlement." Francis Sims, our late secretary, was in receipt of £2 10s. per week, and his office hours were from 9 a.m. till 5 p.m. for five days of the week, Saturdays 9 a.m. till 1 p.m., with one evening per fortnight from 8 till 11 p.m. When away from the office over six miles on business of the Union he was allowed 7s. 6d. per day in addition to rail fares, &c. The false statement being likely to cause a bad impression of our society among employers, trades unionists, and the public, we shall be pleased if you will give this all the publicity possible.

A. Ewer,
General Secretary (pro tem.).

March 15th, 1901.

[The statement complained of was that of the prisoner, not ours.—Eds. Elec. Rev.]

Overhead Wire Accidents.

For the prevention of accidents from "crosses" in tramway work the following method has occurred to me. Let each wire crossing a trolley wire be fixed to special insulators arranged on a fixture provided with a spring arrangement and contacts, so that on the wire breaking the springs will withdraw the insulators slightly and close the contacts, one of which is connected to a good earth, the other to the line wire. This will earth as much of the wire as is in connection with the insulator, and will do this before the wire can reach the trolley wire. Should it touch this a short circuit immediately occurs, which either melts the line wire, opens the circuit breaker or feeder, or blows the fuse in section box.

W. H. I.

Specifications for Carbons.

In a series of articles you have been drawing the attention of readers of the Review to the absurdities and unfair conditions of municipal and other contracts for electrical supplies. In the Hammersmith tender form just to hand, it is stipulated that "Carbons for Arc Lights" must be delivered within "one week" from date of order. Now the bulk of carbons used in this country are made abroad, and by this delivery clause manufacturers are excluded from competing for the business. This means that the poor ratepayers have to pay considerably more for their electrical supplies than they should do if those in authority purchased in the cheapest market.

Then, again, no "Quantities" are stated. How can an outsider possibly judge what they will require in the course of 12 months, and how can he possibly submit a proper tender? They (the borough authorities) know exactly how many of each of the articles in the specification were used during the existence of the previous contract, and they might give the figures. A manufacturer has to cover himself with raw material, but how can he do so without incurring unnecessary risks?

Then, again, it is stated that the carbons are to burn without leaving "any" dust. Are such carbons to be obtained? It seems to me that a clause like this is only opening the door to difficulties with the engineer.

Oscar Schölzig.

[Correspondence.—Pressure upon our space compels us to hold over until next week a letter from Mr. Horace Boot on "Depreciation," also our reply thereto.—Eds. Elec. Rev.]

PARLIAMENTARY COMMITTEES.

Paisley Tramways.—Important Decision.

On Friday, 15th inst., the Earl of Morley, Chairman of Committees of the House of Lords, and Mr. J. W. Lowther, Chairman of Ways and Means of the House of Commons, met under the Private Legislation Procedure (Scotland) Act, 1899, to consider certificates of non-compliance with the General Orders issued by the Examiners in connection with the Paisley District Tramways Provisional Order.

Mr. Kennedy, the Parliamentary agent for Mr. Murphy, of Dublin, and the other promoters of the Paisley District Tramways Provisional Order, addressed the chairman in support of the memorial for the dispensation of the General Orders. The promoters of the Bill had the consent of the Burgh of Johnstone, but not the consent of Paisley, Renfrew or Renfrewshire, and consequently the Examiner had reported non-compliance with the General Orders. His contention was that the circumstances of the case were such as would justify them in asking for the dispensation. He knew this was rather a tall order, to ask that the consent of three local authorities should be dispensed with, but if it were refused it meant a loss out of pocket of some £15,000 or £20,000 to Mr. Murphy and the promoters. It must be borne in mind that it was no new scheme, but one that had been before Committees of Parliament, and had been exhaustively considered. It was a big scheme, and the consent of the local authorities was a difficult matter, but it was the only scheme by which the district could be properly equipped with electric tramways. The Paisley Corporation was promoting a tramway along the line of route, but this, he contended, was simply being done to squeeze more out of Mr. Murphy.

Mr. Spens, the Parliamentary agent for Paisley Corporation, Renfrew Burgh and Renfrewshire County Council, argued against the dispensation, and pointed out that the Parliamentary practice for 30 years had been to insist on the consent of the local authorities for two-thirds of the length of the tramways proposed to be sanctioned. In this case there were 15 miles of tramway, and four local authorities concerned. Only one of the four local authorities had given consent. This was Johnstone, whose consent only applied to one mile of tramway. The instances in which the consent of the local authorities was dispensed with were very rare, and he contended that it ought not to be dispensed with in this case.

After conferring with Mr. Lowther in private, the Earl of Morley said that, having considered the circumstances of the case, they were of opinion that the Order might be allowed to proceed, assuming that the promoters would not dispute the *locus standi* of all the bodies before the local commission.

Mr. Kennedy gave the necessary undertaking.

The result of this decision is that the provisional order goes forward in the usual way, as if there had been no certificate of non-compliance.

Wigan Corporation Tramways.

The Standing Orders Committee of the House of Commons had before it on Tuesday the Wigan Corporation Tramways Bill, in respect of which it was asked that compliance with Standing Orders might be dispensed with respecting the consent of outside authorities for the running of tramways. The Bill was allowed to proceed, but the Committee struck out those parts which related to tramways outside the borough.

South Lancashire Tramways.

Application was made to the Standing Orders Committee of the House of Commons on Tuesday to dispense with the Standing Orders relating to the above Bill. The Committee allowed the application on condition that the clauses relating to two tramways outside the district be struck out.

Chester Corporation Tramways.

Before the Standing Orders Committee of the House of Commons, presided over by Mr. Halsey on Tuesday, the Chester Corporation applied that the Standing Orders should be dispensed with regarding the consent of local authorities. The Committee decided that the orders should be dispensed with on the condition that the powers sought for running tramways outside the borough were struck out of the Bill.

London County Council Tramways.

Before the Standing Orders Committee of the House of Commons on Tuesday application was made by the London County Council for a dispensation of Standing Orders with reference to their tramway Bill, under which powers are sought to construct 40 miles of new tramways. In a number of cases the consent of the local authorities had been refused, and the Committee allowed the Bill to proceed on condition that those parts of the Bill relating to the objecting districts be struck out.

LEGAL.

The Cuba Submarine Telegraph Company, Limited, *v.* The West India and Panama Telegraph Company, Limited.

On Thursday and Friday, March 14th and 15th, the hearing was resumed in the Court of Appeal of this case, an appeal by the defendants from a judgment by Mr. Justice Farwell, who had decided in favour of the plaintiffs on questions which were raised as to the construction of an agreement dated January 31st, 1870, entered into between the plaintiffs and defendants.

Mr. Haldane, K.C., in continuation of his arguments in support of the appeal, contended that the defendants had never threatened or intended to arrange with the Direct Cable Company to transmit messages from London handed by the Direct Company at Jamaica to the defendants for transmission to places south and east of Jamaica at a lower rate than the local rate to such places from Jamaica, or to arrange terms with the Direct Company which should enable the messages handed in by the Direct Company to the defendants at a rate greater than the through rate which had been fixed with respect of messages from London to places south and east of Jamaica *vid* New York and Havana. The defendants further alleged that the plaintiffs claimed to do and had for many years done, and were still doing, the very thing which they now claimed the defendants were not entitled to do.

Mr. Younger, K.C., following on the same side, put before their Lordships some considerations which tended to show that in the agreement which the Court had to construe in this case, the words "telegraphic communication" must be taken with some restrictions. If these words were to be interpreted in the sense that they amounted to nothing more than an ability on the part of the plaintiff company to send a telegram to any particular place, and if the plaintiff company by sending like anyone else a telegram to a particular place, they were within the meaning of the agreement to be deemed to be in telegraphic communication with that place, it would involve this that the plaintiff company must be taken to be in telegraphic communication with every place on the defendant company's system. The result would follow that if a message was handed in at any one station on the defendant company's system for transmission to another place on the same system, that inasmuch as the place of destination was in telegraphic communication with the plaintiff company, that company would be entitled to a proportion of the receipts for that message. Inasmuch as the only obligation under the third clause of the agreement upon the West India Company was to hand over to or forward by the Cuba Company all the telegraphic messages received by or sent through the West India Company for such places as the Cuba Company might be in telegraphic communication with. That in itself amounted to what might be called a limitation. It was put to him that there would be no handing over to the Cuba Company of a message which was to be transmitted from one station on the defendant company's system to another. He ventured by way of reply to say that the wording of the agreement as it stood, as it was construed by the learned judge and by the plaintiffs, was that they might be entitled to some portion of rate paid in respect of a message which never in any sense of the word reached the terminus of the defendant company at the beginning of the Cuba Company's line. In other words, that the plaintiff company claimed to be entitled to participate in messages which were dealt with by the defendant company, although under no possibility could these messages in the course of their transit ever reach Santiago, and there was this remarkable thing to be noticed with respect to the messages which were the direct subject matter of the conflict that the messages never did reach Santiago at all. It could never be supposed that the agreement in question contemplated any interest on the part of the plaintiff company in any message received by the defendant company at one of its stations for transmission to another. He had to contend that in the drawing up of the judgment there had been a grave error. According to his decision the learned judge for the purpose of arriving at the conclusion of what places were in telegraphic communication, made the rates of the rival routes the standard. That was to say, he said that if the plaintiff company could do these services as cheaply as the opposing routes, then the plaintiff company were in telegraphic communication with the places served, as otherwise it would be impracticable, or, from a mercantile point of view, ridiculous to send messages by the plaintiffs' route in order to arrive at the same destination. The declaration, as drawn up, did not in any sense give effect to the declaration, but was clearly wrong. The declaration of the Court, as drawn, declared that the plaintiffs were, according to the true construction of the agreement of January 31st, 1870, in telegraphic communication with every place with which the plaintiffs should be able to communicate by telegraph, or of which the defendants should also be able to communicate by telegraph, in such manner and at such rates as to enable the defendants or any other person or company to compete for traffic with the plaintiffs. The order had been transposed, and the effect of the declaration was to lead to the extraordinary result that the more exorbitant the plaintiff company's rates were, the more easy it was for the defendants, with a lower rate, to compete with them. It was the amount of the plaintiff company's rates not the smallness of them which, according to the formal declaration, constituted telegraphic communication; whereas, according to the learned judge's decision, telegraphic communication depended upon the plaintiffs being equal to or not greater than the rates of other routes.

Lord Justice Williams: If there has been a slip in drawing up the order it can be altered.

Mr. Younger said that it was something more than a slip. It

was the result of elaborate discussion on the minutes, objected to by the defendants, but, at the request of the plaintiffs, acceded to by his Lordship.

Mr. Swinfen Eady, K.C. (with him Mr. Hughes, K.C., and Mr. H. Green), for the plaintiffs (respondents) submitted that the judgment of Mr. Justice Farwell was correct and ought to stand. Having referred to the history of the case and to the rates charged by the two companies prior to the making of the agreement of January, 1870, the learned counsel said that the telegraphic companies had agreed between themselves on a through rate between London and Jamaica at 3s. a word. Before the time of those disputes the through rate to St. Croix as agreed by the plaintiffs and their allies was 5s. 5d. That was to say, a message might be sent from London to Halifax, Santiago, Jamaica, and thence to St. Croix. The through rate for that was 5s. 5d. Supposing a message were handed in at Jamaica for St. Croix, the local rate was 4s. 1d. That was an agreed figure. So that supposing a person wished to telegraph from London to St. Croix by the Direct Company's route apart from any preferential arrangement, the Direct Company would charge 3s. per word for going to Jamaica, and there they would have to hand it over to the West Indian Company, and if the latter charged the Direct Company what they charged others, viz., 4s. 1d., the public would have to be charged 7s. 1d. for the message. The through rate was only 5s. 5d. by the plaintiffs' system. The plaintiffs' complaint was that the defendants, in order to enable the Direct Company to compete with the plaintiffs, instead of treating them as strangers as they were bound to do, did not require the Direct Company to pay 4s. 1d., but had entered into an arrangement with the Direct Company which enabled the latter company to compete with the plaintiffs' system in the St. Croix messages. In other words, the defendants announced themselves willing to work with the Direct Company at through rates, and had arranged to charge them not 4s. 1d. per word, but to charge them such a sum as would enable them to compete with the plaintiffs in the St. Croix messages.

Lord Justice Williams: Do you say that it is impossible for them to say that for all the world their transit rates are 25 per cent. less than their local rates? Might they say, "For all the world we charge for transit rates 25 per cent. less than for local rates?" You say that that would be a contravention of Paragraph 5 of the agreement.

Mr. Eady: If that was the rate they gave to us, I think it would be a breach of the agreement with us so far as regards competing cables. Take Jamaica—they are not to enable any new company to compete with us by reducing their rates. They allowed the Cuba company and their allies a reduction of 25 per cent. to get a working tariff. For them to say, "We will allow your competitors a similar reduction in order to enable them to compete with you," I say that is an agreement prejudicial to us, and which the defendants have agreed not to enter into. The learned counsel, continuing, said that the real dispute was with the Direct Company because that company went to Jamaica. There was not much competition between the plaintiffs and the French Company. He submitted that Mr. Justice Farwell had come to a proper conclusion on the matter, and that there had been a clear breach of the agreement by the defendants, and that the plaintiffs were entitled to an injunction as asked.

Mr. Haldane then replied on the whole case.

Lord Justice Rigby, in giving judgment, said the main question to be decided in this case was as to the meaning of words, apparently most easy of interpretation, contained in an agreement between the plaintiffs and defendants, dated January 31st, 1870. What they had to deal with as the main point was the meaning of the words "telegraphic communication." The contending points were that a company could not be in telegraphic communication with any place away from its own system. That it could only be in telegraphic communication by means of a cable of its own. *Primâ facie* that was certainly not the meaning of the words "telegraphic communication." He considered that in ordinary parlance, so far as the agreement was concerned, the company might be in telegraphic communication with a place not reached by its own cable or telegraphic lines. It might be taken as a certainty that any message which was handed in at Jamaica, and paid for according to the existing through rates to London, would reach London, and it would be idle to say under those circumstances that Jamaica was not in telegraphic communication with London. Telegraphic communication must mean everything which could in the ordinary acceptation of the words be treated as a telegraphic communication. He thought the plaintiffs had made out a case for an injunction, but certain comments had been made upon the words which appeared in the formal judgment which lead to the conclusion that practically it was not so clear as it ought to be, and he thought that those words ought to be reconsidered, and that they should not leave the reader open to any doubt. But in his judgment the plaintiffs were entitled to the declaration as to the words "telegraphic communication" practically as extensive as that which had been put upon them by Mr. Justice Farwell, and that they were entitled to an injunction practically to the extent to which the learned judge had granted the injunction. It was only for the purpose of making the words more clear that it would be necessary to alter the judgment at all. The result would be that the appeal would be dismissed.

Lords Justices Vaughan Williams and Stirling concurred.

Some discussion followed between counsel and their Lordships as to the form of the order, and it was finally left to counsel to arrange, with leave to apply to the Court if necessary.

Mr. Haldane asked that the injunction might be suspended pending an appeal to the House of Lords if such a course was thought necessary.

Mr. Eady said he would not oppose the application if his learned friend would undertake to lodge the appeal not later than the first available day in the next sittings.

Mr. Haldane agreed.

The appeal was accordingly dismissed with costs.

Electrical Machinery for Gold Mines.

In the King's Bench Division of the High Court of Justice on Tuesday, before Mr. Justice Bigham sitting without a jury to try commercial causes, the case of Chester & Co. *v.* the Violet Consolidated Gold Mining Company, Limited, came on for hearing. Mr. Bray, K.C., and Mr. Hallams appeared for the plaintiffs, Messrs. Edward Chester & Co., engineers, of Renfrew; and Mr. Rufus Isaacs, K.C., and Mr. Higgins for the defendant company.

The action was brought to recover £1,946 5s., the balance of the price of a quantity of electrical and other machinery and a bonus of £500 for satisfactory completion of the contract. The total amount of the contract was £43,500, and the machinery, which included a Crompton's electric locomotive, had to be delivered, said Mr. Bray, at the defendants' company's mine at Krugersdorp, in the Transvaal. The answer of the defendants, he believed, was that the defendants were entitled to certain penalties for non-delivery in the time specified, amounting to £2,170, which would more than swamp the plaintiffs' claim. There was at one time a question as to whether they might not be entitled to damages in addition to the penalties, but that had been excluded by his Lordship in chambers. The contract was made in November, 1896. The plaintiffs, who were large manufacturers of mining machinery, guaranteed to deliver the plant at the defendants' mine within seven months, and the penalties for non-delivery at the time specified were to be £100 for the first week, £150 for the second week, £200 for the third week, and so on. These penalties were, however, subject to the usual clauses as to strikes, fires, and other causes beyond the plaintiffs' control. They began to deliver the machinery as early as April, 1897, and everything was delivered by the time specified in July except the electric locomotive and one or two small things connected with it.

Mr. Isaacs said the sole question appeared to be whether the defendants were entitled to recover the penalties.

Mr. Bray said that as far as the penalties were concerned, he purposed to show that there was a fresh agreement. The delivery of the Crompton electric locomotive was delayed owing to a strike in engineering circles, and there was a fresh agreement substituted for the penalty clause.

His Lordship said that if the locomotive was an important part of the machinery, they had failed to deliver the machinery as agreed. He believed the intention was that the penalties were to be enforced.

Mr. Bray: They told us they would not enforce the penalties.

His Lordship: Then you were great donkeys not to have that in the contract.

Mr. Isaacs: Yes, if we said it. He went on to say that plaintiffs were not entitled to the bonus of £500, as they had not completed the contract in time, and the defendants were entitled to the difference between the price of the machinery delivered and the penalties—£223 5s.

Mr. Arthur P. Chester, of the plaintiff firm, said that it was found impossible to buy a Crompton locomotive as specified for in the contract. It had to be specially made and ordered. They used every effort to get the order fulfilled in time. There was a strike in the engineering trade which interfered with the order.

After some legal argument the hearing was adjourned, in order that Mr. Isaacs might have an opportunity of inspecting certain necessary documents and correspondence.

Halsey & Davison *v.* St. James's and Pall Mall Company.

On 12th inst. Mr. John Troutbeck, High Bailiff for Westminster, and a special jury heard this case, which was a claim for compensation for the compulsory acquisition of the premises, 44, 45 and 46, Marshall Street, Golden Square, and the property in the rear thereof, and 47 and 53, Marshall Street, the said premises being required for the extension of the company's generating station and works. The amount of the claim was £9,098, and the jury returned a verdict for £6,500.

Callender's Cable and Construction Company *v.* Killarney Electric Light Company and Goodman.

Mr. Ignatius O'Brien, K.C., in the Chancery Division at Dublin last week, applied on behalf of the plaintiff company for the consent of the Court to some matters of the greatest urgency. The action was brought by debenture holders of the Killarney Electric Light Company to raise the amount of their debentures. Mr. Goodman had been appointed Receiver pending the hearing of the cause. The defendant company was incorporated under a provisional order in 1891 by which the undertakers were bound to continue the supply of electricity, and if they failed to so supply electricity they were liable to a penalty of 40s. for each day. Although the assets of the company were extremely valuable, and would ultimately realise a considerable sum, yet owing to the manner in which the company had been worked for some years the machinery had become defective, and the result (as we gather from a report appearing in the *Irish Times*) was that a portion of the town of Killarney was left in darkness in consequence of the breakdown of the machinery. The plaintiffs, who are electrical engineers, seeing it was necessary

to continue the supply, entered into an arrangement to repair the machines, and at the present time the machinery was going, the town being kept fully supplied with light. The most valuable asset of the defendant company was a contract with the Killarney Urban District Council for the electric lighting of the town. That contract would expire next day (Wednesday), and tenders had been invited for a supply of light for the ensuing two years, the Gas Company being also invited to tender. The Receiver had communicated with the plaintiffs, and in a letter written by him he stated that the directors of the defendant company would not tender without the consent of the Court. Counsel thought it would be a great pity if this contract should be lost. In order to carry out such a contract a question arose as to whether it could be done without appointing the Receiver as manager pending the action.

After hearing the arguments of counsel, the Master of the Rolls said he was sorry this company had got into such a position. He hardly understood the reason, because on the figures in the affidavits it might certainly at least be able to pay its way. It would be a matter of public regret that an electric lighting company should cease to exist in a place like Killarney, where there were not only streets to be lighted but also large hotels. His Lordship, however, had nothing to do with that. This was an action of debenture holders against the company, and he had no jurisdiction or power to interfere further than was necessary to preserve the property which was charged with the plaintiffs' mortgage. His Lordship saw no reason to appoint a manager, and as to the contract for lighting the town he thought steps ought to be taken to send in a tender for that purpose. He would make an order to that effect, and also allow the payment of the rent and the hire of the machine to be made salvage claims. The other matters must stand over.

CURRENT SPECIFICATIONS.

LIII.—WARRINGTON ELECTRIC TRAMWAYS.

Summary.

Extent of Contract.—Section No. 3, supply of eight completely-equipped tramcars.

Gauge of Line.—4 ft. 8½ in., laid with girder rails weighing 90 lbs. per yard.

Type of Car.—Double-deck mounted on usual type four-wheel trucks.

Capacity of Cars.—Each to seat about 40 passengers.

Design of Car Body.—Preferably one of tenderer's standard patterns, drawings and full specifications to be sent in with offer.

Details of Truck.—To have wheel-base 6 ft. 6 in., and steel-tired wheels 30 in. diameter.

Types of Brakes.—Powerful hand-brake to be operated from either platform and in addition an electrical emergency brake.

Type of Trolley Pole.—To be of the swivelling pattern with enclosed springs.

Capacity of Motors.—To be capable, when the two installed on each car are connected in parallel across the 500-volt traction circuit, of propelling a fully loaded car up a gradient of 1 in 40 at a speed of 10 miles per hour.

Type of Controller.—To be of usual series-parallel pattern, fitted with electrical emergency brake.

Date of Delivery.—To be specified by tenderer in his offer.

Penalty for Late Completion.—One-half of 1 per cent. of total contract sum for every week's delay beyond stated period.

Specified Terms of Payment.—Up to 60 per cent. on engineer's monthly certificates, 20 per cent. additional when cars are ready to be placed in public service, 10 per cent. on completion of contract, 10 per cent. at end of six months' period of maintenance.

Period of Maintenance.—Six months from date of completion.

Stipulations as to Wages paid to Workmen.—Recognised fair rates of wages to be paid.

Arbitration Proposals.—Qualified arbitration clause; see comments below.

Date for Receipt of Tenders.—March 27th, 1901.

This specification has been issued by the well-known electrical experts, Messrs. Preece and Cardew, who act as consulting electrical engineers to the Corporation of Warrington.

The requirements are expressed in general terms, and tenderers are invited to send in offers for standard designs of cars. The wording is of such an open character that no well-designed apparatus is precluded from competing. This is as it should be, and is in marked contrast to many of the specifications which come under our notice.

The general conditions in many respects approximate to the standard agreed upon between the Municipal Electrical Association and the Electrical Plant Manufacturers' Association. The drawings to be sent in with tender are distinctly specified, the date of completion is to be stated by tenderer in his offer, and the penalty for non-completion by this date is *one-half of one* per cent. per week.

There is nothing to object to in the stipulation that rates of wages recognised as fair in the district in which the work is carried out shall be paid to all workmen, and that usual hours of labour shall be worked.

The arbitration clause is not, however, of the unqualified character we desire to see become general in electrical engineering contracts. All details as to quality of work and the meaning of the specification, are to be subject to the final decision of the engineers; disputes affecting the financial part of the contract may be referred to the arbitration of someone appointed by the President of the Institution of Civil Engineers.

While in special cases, clauses of this descriptions may be accepted without much risk, yet as a matter of principle we much prefer that not only financial, but *all* disputes may be subject in the last instance to the arbitration of an independent authority.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Mar. 20th, 1900.		Week ending Mar. 19th, 1901.	
Adelaide	£550	Adelaide	£46
„ Teleg. mat.	456	„ Teleg. cable	27,000
Amsterdam	855	„ Teleg. mat.	60
Auckland	114	„ Teleg. wire	890
Beira	64	Amsterdam	76
Bombay	69	Auckland	100
Brussels	90	Bombay	82
Buenos Ayres	400	Brisbane. Teleg. cable	274
„ Teleg. mat.	280	Buenos Ayres	84
Calcutta	1,094	Calcutta	1,685
Canterbury	14	„ Teleg. cable	725
Cape Town. Teleg. mat.	118	„ Teleph. cable	195
„	20	„ Teleg. wire	116
Colombo	72	Cape Town	758
Copenhagen	358	Colombo	14
Delagoa Bay	2,621	Cologne. Teleg. cable	1,102
Durban	117	Copenhagen. Teleg. wire	18
„ Teleg. mat.	747	Demerara	816
East London	155	„ Teleg. mat.	82
Fremantle	104	Durban	154
Gibraltar	27	„ Teleg. wire	362
Gothenburg	40	Flushing	25
Halifax. Teleg. cable	1 0,000	Gibraltar. Submarine cable	1,750
Hamburg	30	Kobe. Teleg. cable	8,650
„ Teleg. mat.	100	Malta. Teleg. cable	1,750
Kobe. Teleg. cable	941	Melbourne	1,944
Melbourne	412	„ Teleg. mat.	44
„ Teleg. cable	201	Nagasaki	747
Monte Video. Teleph. mat.	148	Ostend	25
Reval. Teleg. mat.	400	Penang	18
Rotterdam	427	Perth	180
„ Teleg. mat.	600	Port Chalmers	126
Singapore	114	Port Said	15
„ Teleg. mat.	407	Rockhampton	54
Sydney	1,778	St. Petersburg. Teleg. mat.	34
Wellington	198	San Sebastian	85
„ Teleph. mat.	318	Shanghai	311
Yokohama	442	Singapore	306
„ Teleph. cable	206	„ Teleg. mat.	346
		Sydney	409
		Wellington	285
		Yokohama	466
Total	£134,627	Total	£51,909

Foreign Goods Transhipped.

Brisbane. Teleph. appar. Value £178 | Gothenburg. Teleg. appar. Value £15

Bankruptcy Proceedings.—Under the failure of Johnstone, Benjamin & Co., electric wire and cable manufacturers, lately trading at 10, Ascham Street, Kentish Town, the debtors attended on Wednesday last week at the London Bankruptcy Court for their public examination. They had filed accounts showing total liabilities £8,116 3s. 11d., of which £7,480 7s. 8d. is expected to rank against assets valued at £5,912, and consisting mainly of shares in Johnstone, Benjamin & Co., Limited. Mr. E. S. Grey, Assistant-receiver, applied for the examination to be adjourned, on the ground that he required further time for investigation purposes.

Mr. Whateley, on behalf of the trustee, asked leave to open the examination. His client proposed to launch a motion before the Judge with a view to upsetting the assignment of the business to the company, and it was desirable that certain particulars should be obtained at that sitting. The debtors, Ernest Emanuel Benjamin and Lewis Benjamin, were accordingly sworn, and questioned by Mr. Whateley regarding the conversion. They admitted that they were being pressed by creditors in December last. The company was promoted in that month by Mr. Phillips, a relative, who received £500 cash and £500 shares for his services. They (the debtors) had acted as managing directors of the company until the failure in January last. The debentures of £2,200 received by them as part of the purchase money had been handed over to other persons. Lewis Benjamin had delivered 11 £100 bonds to the trustees of his marriage settlement, and Ernest E. Benjamin had disposed of nine £100 bonds in a similar manner, his other two bonds being handed to a gentleman who had advanced him £150. They each received £250 in cash, which was handed over to the promoter, and certain shares, which were now in the hands of the Official Receiver. Mr. Whateley intimated that he would reserve

further questions until the adjourned sitting, and Mr. Registrar Giffard ordered the case to stand over for a fortnight.

According to the observations of the Official Receiver, and the statements of the debtors, it appears that Ernest Emanuel Benjamin in 1890 with a small amount of capital commenced business as a wire merchant at 24, Mildmay Park, N., where he traded under the style of Johnstone & Benjamin. In 1892 he removed to Balmer Road, Bow, and added to the business that of manufacturer of electric wires and cables, and metal merchants. He was shortly afterwards joined by Lewis Benjamin, who introduced £300 capital (most of which he borrowed), and received a half share in the business, which was thereafter carried on under the style of Johnstone, Benjamin & Co. They removed to 3, Wenlock Road, City Road, in 1894, and from there to the Crown Electric Works, Ascham Street, Kentish Town, in August, 1900. On December 20th last they transferred the lease and goodwill of the business, and their plant, utensils, stock-in-trade, cash at bank, and good book debts (all valued at £9,200), to a limited company, registered in the name of Johnstone, Benjamin & Co., with a nominal capital of £15,000 in £1 shares, of which only 697 appear to have been subscribed, in consideration of their appointment as managing directors of the company, at a salary of £250 per annum each, for a term of seven years, and the payment to them of £9,200 payable as to £500 in cash, £1,500 in ordinary shares, £5,000 in deferred shares, and £2,200 in debentures bearing 4½ per cent. interest. They attribute their failure and insolvency to pressure by creditors, to loss in trading (in consequence of the disturbance to the trade through the removal of their business in August last, and want of capital), to extra expenses occasioned by such removal, and by adapting their new premises to their requirements, to bad debts, and inability to realise their shares in the limited company.

At Dundee on 13th inst. a petition for sequestration by Hiley and Orchar, electrical engineers, North Tay Street, Dundee, was submitted. James Matthew Hiley, partner, appeared for examination, and in answer to Mr. H. S. Glenny, solicitor, who appeared on behalf of the trustee, Mr. R. C. Thomson, said his partner, William Orchar, had left for Hong Kong. They commenced business together in January two years ago, Mr. Orchar buying the necessary machinery at, he believed, nearly £100. He himself had no capital. The state of affairs of Hiley and Orchar showed assets £174 16s. 5d., and liabilities £378 3s. 11d.; of James Matthew Hiley—assets, *nil*; liabilities, £5 (consisting of rates and taxes); of William Orchar—assets, £121 5s.; and liabilities, £5. The statutory oath was administered, and Mr. Glenny asked a commission to examine Mr. Orchar. Mr. A. Bell said Mr. Orchar had granted him power of attorney, and he could give all information. Mr. Glenny said an attorney could not take a bankrupt's place, and the commission was granted.

Liquidations.—A meeting of the Macroom Electric Lighting Syndicate is to be held at Manchester on April 16th to hear an account of the winding-up from the liquidator, Mr. Henry Shaw.

A similar meeting of the Phaeton Electrical Company is to be held at 6A, Austin Friars, E.C., on April 23rd, to hear an account of the winding-up from Mr. W. J. Ogden, liquidator.

Catalogues and Lists.—Messrs. Geipel & Lange have issued specifications of the Ward-Leonard motor starters of the S U and S K types.

The London Electric Wire Company, Limited, has brought out a new (March, 1901) trade list of insulated wires and cables for electric lighting, telephones, instruments and bells.

The New Brotherton Tube Company, Limited, of Wolverhampton, send us their list of Excelsior enamelled steel conduit and fittings. They have opened an office and stores at 66, Victoria Street, S.W., for the convenience of their London and South Coast customers. Large stocks of specialities in conduit and fittings will be kept at that address to ensure prompt delivery.

We have received from the General Electric Company (1900), Limited, the tenth edition of the "S" section of their catalogue, comprising switchboards, accessories, and incandescent lamps. The list contains many novelties, a special feature being made of the "Peel" and "Adelphi" main switches. The "Peel" switches are an improved form of knife switch for 250 volts, which is provided with a new type of spring break, the spring action being on the blade and not on the handle. They are well standardised, being listed from 30 to 1,000 amperes, as "single" and "change over," and single, double and triple-pole. The "Adelphi" switches are already familiar to our readers. All the company's standard switchboards are now fitted with these two switches. Amongst other new switches appearing in the list is a rectangular battery regulating switch, listed in four sizes from 8 to 20 ways, and an H.T. 10,000-volt switch, having only the lever accessible, whilst the contacts, which work in an insulated tubular air chamber, can be placed at any distance away. A new watertight switch for incandescent lamp posts is shown for 5 and 10 amperes, mounted in a C.I. case tapped to take the barrel and provided with a lever arm for manipulation from the pavement; also four new arc lamp-post switches for various functions. Among the smaller things is a new pressel, readily manipulated with one hand; a dust-proof floor socket with automatic arrangement for closing the holes on removal of the plug; a china adapter fitted with fuse terminals; "loop-in" ceiling roses; a new "side-contact" ceiling rose with D.P. fuse terminals; high tension distributing boards with "lined chamber" fuses, and an excellent series of watertight house service and tramcar cut-outs for 110 volts and 500 volts. Considerable space is devoted to the "Robertson" lamp, and amongst novelties in this line we notice the special lamp for traction and tramcar work.

Messrs. Johnson & Phillips' Electric Cable Works have issued a reduced price list of their vulcanised I.R. cables and wires.

Concert.—A smoking concert was held last week by the staff of the Sheffield Corporation Electric Supply Department. Mr. Fedden presided, and in reply to a toast, remarked that things were only in their beginning with their department. When they got their new power house going he hoped to be able to supply the electric current for canal boats, for distant portions of the tramway system, and also for small and large works at a rate cheap enough to induce manufacturers to start factories in Sheffield.

Electrical Development in Spain.—The commercial attaché to the British Embassy at Madrid, in a report issued by the Foreign Office and abstracted in the *Birmingham Daily Post*, makes the following very interesting remarks concerning the progress of electrical undertakings in Spain, and the openings for British enterprise:—The improvements in the systems of electric tramways have given fresh impulse to the companies interested in them. During the last few years the increase in electric tramways in Spain has been very rapid; the various lines already cover upwards of 150 miles, and concessions for additional tramways in and connecting various towns have been granted. The general use of electricity is causing the introduction of many valuable industries into practically deserted districts. Until a few years ago the streets and houses of most of the small towns and villages, which are now well lighted with electricity, were dependent on a few oil lamps and the lanterns of the night watchmen. Once an electrical plant has been put in a village it becomes necessary to employ skilled labour. The residence of a few people of superior education in a village soon puts new life and energy into all its undertakings, and other improvements follow. The introduction of factories, and opportunities of exercising skilled labour in country districts, tends to encourage the rural population to take more interest in education, so as to fit themselves to compete for better wages. The lack of education in the small towns and villages remains an impediment to rapid progress in industrial life. In agriculture the methods and implements of past ages are still employed. As it is the exception for an agricultural labourer to be able to read, the explanations ready at hand in books and newspapers are lost to him, and there are no means of demonstrating the advantages of machinery, manures, and inventions for increasing production and reducing labour. To obtain a good position in business in Spain intimate knowledge of the language is essential. The many openings in the electrical business in Spain are just what is necessary for young men to fit themselves for more important posts. Young English engineers and mechanics with good recommendations, who would not object to pass a few years in quiet towns or villages, would probably find ready employment under some of the great firms interested in the electric light business. As the trade with England is not only the most important, but is at the same time most profitable to Spain, it is evident that Englishmen should not find it difficult to obtain employment, especially those with practical training in any special industry. Englishmen wishing to come to Spain should not think of settling in Madrid, which, although the Government centre, is not a commercial city, and offers few openings for foreigners. It would be preferable to search for employment in a country town, where they could learn the language quickly, and at the same time study the customs and requirements of the country so as to be ready for any opportunity that might offer itself.

Electrical Trade in Natal.—For the 12 months ended December 31st, 1900, telegraph materials, &c., were imported into Natal to the value of £27,555, as against £32,925 for the corresponding period of 1899. The exports from Natal to the adjacent territories during the past 12 months include electrical apparatus (52 packages), £1,301; and electrical belting (five packages), £115.

Fined.—At Stratford on 17th inst., a Leyton hosier was fined £5 and costs for laying an electric wire connecting with the electric light mains of the Leyton U.D.C. without that body's consent.

For Sale.—In consequence of the removal of Mercier's Patents Company, Limited, of Manchester, Messrs. Heap, Son and Norman are offering certain surplus stock and plant for sale. See advertisement pages this week for details.

A German Westinghouse Company.—The Westinghouse Electric and Manufacturing Company, through the Westinghouse Company, Limited, of London, has recently caused a company to be organised in Germany, known as the Westinghouse Electricitäts Aktiengesellschaft, with a capital of 1,000,000 marks, for the purpose of selling the apparatus of the Westinghouse Electric and Manufacturing Company. Felix Singer has been appointed a member of the vorstand, or managing board. The company's main office is at 19, Jägerstrasse, Berlin, and it will represent the Westinghouse interests in Germany, Austria, Hungary, the Balkan States, Turkey in Europe, Turkey in Asia, and Greece.—*Electrical World*, New York.

Germany.—The German Electro-Chemical Society will hold its annual general meeting in Freiburg (Baden) from April 17th to the 20th next.

Gold Mining by Electricity.—The chairman of the Mysore Goldfields Company told the shareholders last week that they were carrying out a great scheme under which a considerable portion of the company's mines will be worked by means of elec-

tricity. The necessary power for effecting this would be derived, he explained, from the Cauvery Falls, some 90 miles from the Colar goldfields. The scheme was due to the enlightened initiative of the Mysore Government, and would cost them half a million of money altogether. It was anticipated that a large saving would accrue to the working of the whole of the mines. The installation, it was expected, would be completed in 12 or 15 months from now.

India.—The power of the Karteri Waterfalls is to be utilised for driving a cordite manufactory in Conoor by electricity. The electrical energy will be transmitted over three miles from the point where the Günther turbines and generators will be erected. The generators, it is stated, will be made by the General Electric Company, Limited, on the polyphase system, under licence from the Oerlikon Company. It is a source of gratification that this work is being done by English manufacturers. We trust that others in this country will give close attention to the electrical requirements of India.

The Installation at Messrs. Milnes' Works.—With reference to our recent article describing the electrical installation at the works of Messrs. G. F. Milnes & Co., Limited, Hadley, the British Schuckert Electric Company, Limited, have written to us pointing out that the three six-pole generators as well as the switchboards were supplied by them, and are not of the B.T.H. type.

A Large Contract for Westinghouse Transformers.—The Westinghouse Electric and Manufacturing Company have recently received the largest record order for transformers. These are to be supplied to the Chambly Manufacturing Company, a large electric power and lighting concern of Chambly, Canada. The order is for 20 transformers of 2,750 KW. each. The transformers are all of similar construction, of the air-blast type and of similar transforming ratios. Ten are to be used as step-up transformers from two-phase current at 2,200 volts pressure to the 25,000 volts three-phase transmission line pressure, the other 10 are to be used for stepping down the 25,000 volts three-phase pressure at the receiving end of the line back to two-phase current at 2,400 or 4,800 volts as required. Each transformer has a weight of 11 tons and stands about 9 ft. high. The construction of the transformers has been carried out on the well-known Westinghouse principles. The windings, both primary and secondary, are split up into several flat coils with few turns per layer, the electric pressure between adjacent points of the coil being thus reduced to a minimum. The sub-division of the coils is also an advantage for the repair or replacing of parts of the winding; in the case of the transformers under notice it is not necessary to send a transformer back to the manufacturers, coils can be easily replaced with the transformer in its operating position. The efficiency of these transformers is over 98 per cent. The iron and copper have been properly proportioned to secure the minimum losses, and the iron used is specially prepared and treated to render its magnetic properties as permanent as possible, there being no increase in the iron losses of Westinghouse transformers after continued terms of service. The results of over 15 years of experience in the production of the highest and most widely adopted class of transformers are embodied in the Westinghouse transformers. It is almost unnecessary to mention that all electric apparatus, including transformers, are subjected to the most rigorous tests before leaving the manufacturing works. The transformer tests extend over a long period of time, often 12 months of actual work on load, the iron and copper losses being accurately measured before and after the test. The air blast for the cooling of these large transformers is supplied by blowers driven by Westinghouse induction motors of type "C." Terminals are fitted to the transformer whereby the arrangement of primary and secondary in series or parallel for various ratios can be easily carried out. The change from two-phase to three-phase and *vice versâ* is made by the arrangement invented by Mr. C. F. Scott, of the Westinghouse Company, and now generally adopted.

London County Council.—The Fire Brigade Committee at a meeting of the Council on Tuesday reported that they proposed to recommend an extension of the electric lighting installation at the chief fire brigade station, and that it would be necessary to obtain additional plant for the purpose. The cost was estimated at £500, and it was proposed to obtain tenders from selected firms at once. It was decided to authorise the Committee to invite and open the tenders for early consideration by the Council.

The following councillors were appointed to form the Highways Committee for the ensuing year:—J. A. Baker, R. M. Beachcroft, J. W. Benn, E. Browne, Sir J. Dickson Poynder, N. W. Hubbard, W. C. Johnson, S. Low, M. Mayhew, R. Parker, the Hon. W. R. W. Peel, R. C. Phillimore, D. S. Waterlow, T. Wiles and T. McKinnon Wood.

The Council adopted without discussion a motion proposed by Mr. Spokes, and printed in our "Notes" last week.

Robertson Lamps.—The new extensions to the "Robertson" Lamp Factory were opened on Saturday, March 16th, when the company gave a tea to 300 of their employés. The tea was followed by a concert to which the employés invited their friends, and a company of nearly 700 enjoyed an excellent entertainment. The concert was held in the large hall, which has been set apart by the directors for the purpose of a dining hall for the employés. In addition, this room is intended to be used for concerts, dances, &c., which are held periodically by the employés.

Tennis by Arc Light.—Several energetic sportsmen in Lincoln have succeeded in utilising the electric light as a means of securing healthy recreation on winter evenings. A small committee guaranteed the expense of fitting the Drill Hall with six arc lamps, which were duly installed by the "Free" Wiring Company. The committee then had a tennis net made with an unusually broad white strip of linen along the top. By this means "lawn" tennis under novel conditions is enjoyed with the best results. Experiments were made with many coloured balls, but it was found that the ordinary white tennis ball was the best for seeing purposes. The experiment has proved a great success and might be copied in other towns.

Trade Announcement.—Mr. J. H. Heathman, of ladder fame, has just opened extensive factories at Parson's Green, Fulham, where he will have increased facilities for turning out his specialities with promptitude.

ELECTRIC LIGHT AND POWER NOTES.

Arbroath.—The Corporation, having resolved to apply for borrowing powers to the extent of £40,000 to carry out the installation of the electric light in the burgh, have appointed Messrs. Buchan & Hogarth to be their electrical engineers.

Bombay.—The Municipal Council has passed a resolution empowering a committee to make arrangements with the Pioneer Electric Light and Power Company, of London, to take up the electric light and tramway concessions for Bombay. The company, we understand, is prepared to spend £1,000,000. It has already obtained the concession for Adelaide and Auckland.

Burton.—The T.C. has resolved to charge for power 3d. per unit for the first 117 hours' use per quarter, and 1d. afterwards.

Cape Town.—The Electric Lighting Committee of the Town Council reported that during the month of December last, 18,422 units of electricity were generated by steam-power at the electric lighting works, and 40,470 units by water-power, making a total quantity of 58,622 units, of which 12,470 were consumed for the purpose of street lighting, 37,452 by private consumers, 1,000 upon the works, 4,290 units for meters, while distribution losses amounted to 3,320 units. The total number of private consumers was 587, and the equivalent number of 8-C.P. lamps, 34,700, whilst motors were employed to the extent of 247·25 H.P.

Clacton.—A syndicate has offered to provide tramways and electric lighting, but the Council has its own powers, and has declined these overtures.

Cleethorpes.—Mr. Vesey Brown, who has already reported upon certain electrical matters to the Council, is being asked to report on the question of incandescent lamps for street lighting.

Dalkeith.—Details have been finally adjusted in connection with the electric lighting of Dalkeith by Messrs. Crompton and Co.

Dublin.—A special meeting of the City Council was held last Friday to consider a report of the Lighting Committee, recommending that the tender of Messrs. J. & W. Stewart be accepted for the electricity works buildings for the sum of £29,051. The first reading was passed, but a motion to suspend the standing orders, to enable the report to be confirmed at once, failed to obtain the necessary two-thirds majority, and the meeting was adjourned.

Farnworth.—Operations for laying the cables for the lighting and traction system have commenced this week, the work being in the hands of the British Insulated Wire Company, Limited. The Council's generating station in Albert Road is advancing towards completion, both as regards structure and equipment, and it is anticipated that on an early date the current for lighting will be available. The plant includes three Lancashire boilers, driving three vertical compound engines of 200 H.P. coupled to three dynamos of 120 KW. output. There is also being provided a set of accumulators of 250 cells. Messrs. Lacey, Clirehugh & Sillar are the engineers.

Fife and Kinross.—At a meeting of Fife and Kinross Lunacy Board last week, a report by Prof. Baily on the proposal to light the asylum by electric light, and giving estimates for the work, was submitted. The prices ranged between £2,000 and £3,000.

France.—A syndicate which has been brought together for the purpose has submitted a proposal to the towns of St. Maurice-sur-Moselle and Bussang, in the department of Meurthe et Moselle, for the supply of electric light to these towns. The power station would be constructed between the two towns, which are 2½ miles apart.

Heston — Isleworth.—The U.D.C. has adopted a scheme of electric lighting by arrangement with the Richmond Electric Lighting Company.

Heywood.—The T.C. has received a letter from the L.G.B., sanctioning the borrowing of £15,000 for electric lighting, but stating that applications for loans for free wiring of consumers' premises can no longer be entertained.

Hornsey.—The E.L. Committee has received sanction from the L.G.B. to the borrowing by the Council of £73,500 for purposes of electric lighting, and formal approval of the proposed site in Tottenham Lane, Hornsey, for a generating station.

Italy.—The engineers, Chiarini and Asquini, of Rome, have secured a concession for the electric lighting of the towns of Zagarolo and Frascati, with six neighbouring communes. The same engineers have applied for a concession for the supply of motive power necessary for the traction of the Rome—Frascati electric tramway.

Keighley.—The Corporation has this week accepted the tender of the Telegraph Manufacturing Company, Limited, Warrington (of £76), for cables for wiring the electricity works; and approved the action of the Electricity Committee in causing a petition to be deposited in the Private Bills Office against the Electric Power (Yorkshire) Bill, and in deciding to lodge a petition against the South Yorkshire Electric Power Bill, 1901.

Kimberley.—The borough electrician has been asked to report on the possibilities of extra lighting. The local postmaster recently wrote to the Council to inquire whether it was now possible to fix an approximate date upon which the Council would be prepared to undertake the continuous supply (day and night) of current for the electric lighting of public buildings, &c., as the Postmaster-General had in view the taking of a sufficient vote on the Public Estimates to cover the cost of installation of electric light in the post office building. The matter was referred to the Lighting Committee, the mayor remarking that this question of continuous supply was one which they would have to face very shortly.

Leicester.—At a meeting of the T.C. last week Alderman Lennard said that with regard to the capital account in the electric light undertaking they had spent up to Christmas last £133,613. They had a total revenue of £8,032, against £5,885 in the corresponding half of last year, an increase of £2,147. There had been an increase in the expenditure of £1,455, and they had £4,233 to carry to the profit and loss account, against £3,541 last year. The chief cause of the increased expenditure was to be found in the cost of fuel, more than double being paid for fuel and other items, such as rates and taxes, &c. They had a profit of £1,287 5s. 8d., after paying £1,068 3s. 1d. on account of the sinking fund. They had now £2,400 to the good, after paying all the charges on a new business. They had not found it necessary to raise the price per unit at all.

Leith.—The accounts of the electricity department show that the capital expenditure to date has been £44,014. £1,000 was taken last year from the burgh general assessment to meet the estimated deficiency for the year; of that £650 was required, and £350 was brought forward as a credit balance to the year just closed. It was hoped that the revenue account would meet all the charges, but it had been found necessary to charge against the assessment a debit balance of £378 10s. 10d. If coal could have been bought at 6s. 8d. per ton, the price of the previous year, the revenue would have shown a surplus of £435 instead of a deficit. The income was:—From private lighting, £3,041; from motive power, £1,247; from public lighting, £2,160; miscellaneous receipts, £15—total, £6,385. The cost of generation and distribution was £4,743, leaving a surplus of £1,641. This, added to the credit balance brought forward, gave a total of £2,370 to meet payment of interest, £1,602, and repayment of capital, £1,208. The accounts indicated that now that the price of coal was reduced there would be no further demand on the rates.

Lynn.—The T.C. has resolved to grant a bonus of 100 guineas to the electrical engineer, Mr. J. Pilling, on the completion of the extensions at the electricity works, and to raise his salary from £150 to £200, with house, coal, light and water free.

Matlock.—It is stated that the Smedleys Hydro. Company, Limited, have bought the old disused mills near Matlock Bridge for an electric power station.

Paisley.—The accounts of the electric lighting authority for the year ended December 31st show a deficit of £4,723 on the year's transactions. The auditor in his report pointed out that the expenditure on the capital account was £17,057 in excess of borrowing powers. He thought that in addition to the sinking fund for the redemption of capital, the Corporation ought to consider the advisability of creating a depreciation account for buildings, plant, machinery, mains, &c. Ex-Provost Clark urged the Corporation as business men not to delay for a moment the formation of a depreciation account. The matter was remitted to a committee.

Paris.—A new company is being formed in Paris to be known as La Société Nord Lumière to supply electrical energy for lighting and power purposes in the western and northern suburbs from Courbevoie to Montmorency.

Port Elizabeth.—The Borough Council have resolved to make application to the Governor of Cape Colony for permission for the Council to enter into an agreement with any company, or for them to undertake the lighting of the town by electricity, and to supply private consumers.

Radcliffe.—The D.C. has decided to increase its application to the L.G.B. for borrowing powers to £21,500 for electric lighting and traction works, and to apply to the B. of T. for power to borrow £60,000 for the construction and equipment of electric tramways.

Railway Train Lighting.—The *Times* states that a new system of electric lighting has been tried experimentally in several carriages of the London and South-Western Railway, and should it prove successful the scheme will be generally adopted. Each compartment is to be fitted with four lamps, whilst one switch (which will be under the control of the guard) will serve a whole carriage of about eight compartments. The lamps are placed in convenient positions, so that passengers occupying corner seats will be enabled to read with the same degree of comfort as others in the compartment. A newly-fitted carriage at Waterloo Station was open to inspection on Thursday last week.

Richmond and District.—The B. of T. has convened a conference between representatives of Richmond, Ham, Hampton, Hampton Wick and Teddington to consider the application of the Richmond Electric Lighting Company to supply the outlying districts named. The Richmond Corporation last week decided to instruct their delegates to oppose the application in view of the option the Council has of purchasing the company's works.

Peterborough.—The demand for electric light at Peterborough continues to be steady, and already the mains have been extended beyond the limits originally proposed.

Rochester and Chatham.—The Gillingham D.C. has decided to purchase the Rochester, Chatham and District Lighting Company's undertaking in their district. The Chatham Corporation has offered £20,000 for the company's undertaking in the borough, but to all appearances Rochester will not join in the scheme. Messrs. Norman & Stigant (solicitors to the company) have written to the Rochester Corporation that the directors consider the amount at which they value their property so much in excess of the sum offered by the Corporation that it would be useless for them to name a price. They, however, adhered to their offer to sell at a valuation by arbitration on a certain basis mentioned in their letter. It was resolved that the Corporation could not agree to purchase the undertaking upon the terms named, and that the offer already made would be withdrawn if not accepted within a month.

Rothesay.—The T.C. has decided to call in expert advice, as the electricity supply is said to have failed 52 times during the last winter.

Salford.—A L.G.B. inquiry was held last week into the application of the T.C. for permission to borrow £8,771 for the purposes of electric lighting.

Seaford.—A syndicate of local gentlemen some time ago took up a prov. order for the purpose of supplying Seaford with electric light. The result, however, has not been as successful as it was anticipated it would be, and the syndicate approached the U.D.C. with a view to that body taking over the order. The Council has now agreed to do so on very favourable terms.

Shannon Power Bill.—A meeting of the Joint Subcommittee of the Corporation and Harbour Board took place last week to consider the draft clauses sent by the promoters' Parliamentary agent.

Southampton.—The Electricity Committee has received the sanction of the L.G.B. to the borrowing of £12,000 for the purposes of electric lighting.

Stirling.—The T.C. is already arranging for a considerable extension of plant, although it is barely a year since the station was opened. The tender of Messrs. Siemens Bros., amounting to £4,297, for their own dynamo coupled to a three-crank engine built by Messrs. Allen, Son & Co., of Bedford, has been accepted. An offer by Messrs. Kelvin & James White, Limited, to supply the extension to the switchboard for the sum of £453 15s. 3d., has been remitted to Messrs. Kennedy & Jenkin to report.

Sunderland.—At the meeting of the T.C. last week, the proposal of the Lighting Committee to erect other 82 electric arc lamps in the principal thoroughfares was discussed. The 82 lamps would take the place of 144 gas lamps, and the cost would be £3,282. The annual cost would be £1,142 10s., as against £439 4s. for the gas lamps. It was agreed to erect 16 arc lamps in addition to those recommended by the committee, or 98 in all.

Tiverton.—The Lighting Committee reported to the T.C. last week that they were still in communication with the B. of T. on the subject of the construction of the weir in the River Exe for the proposed electric lighting works, and that, with a view to confirming a report of the electrical engineer as to the sufficiency of the water-power, the Committee considered it important that the opinion of a hydraulic engineer be obtained. The Council decided to obtain the opinion of an engineer on the whole scheme.

Windsor.—It is announced that the electric light, which is now limited to the State apartments and to the corridor, is to be extended to all parts of the Castle.

Worcester.—At a recent meeting of the City Council, the Electricity Committee reported that they had received an application for the supply of electricity to Red Hill and Whittington. Mr. Parker moved that, subject to owners guaranteeing an annual return of 20 per cent. on the Council's outlay within the city, and paying the cost of the main outside the city, the engineer be instructed to extend the main to Whittington. The Committee anticipated a return equal to 32 per cent. on their outlay. The

town clerk advised that this proposed proceeding was illegal, but the Committee, in defiance of that advice, approved doing the work. The resolution was carried.

Wynberg (Cape Colony).—At a recent meeting of the Municipal Council, a letter was read from the electric light company requesting the Council not to avail itself of its option to buy the company's concern in 1902, but to extend the time by five years. The request was acceded to on condition that the company consider Diep River and Plumstead as part of the municipality of Wynberg.

ELECTRIC TRACTION NOTES.

Barmen—Elberfeld.—The first section of the new suspended railway between Elberfeld and Barmen, officially opened by the German Emperor in October last, and described in the Electrical Review, was thrown open to the public the week before last. The opening was made an event of by the people of Elberfeld and the other inhabitants of the Wupper Valley. The directors of the concern had the foresight to keep the fact and date of opening a secret, so as to avoid too great a crush. Some further trial runs were made early on the morning of the opening day, and as these came off without the slightest hitch, the barriers leading to the stations and waiting rooms were thrown open shortly after 8 a.m., and the unique railway was opened without special ceremony. The cars were immediately besieged by passengers, and all space, even standing room, was crowded by people, anxious to experience the novel sensation of travelling on a mono-railway with car suspended in mid-air. We are informed that the runs were made without any hitch whatever, and the cars, as was proved in previous trials, travel quietly and without shock or jarring. They take the sharpest curve without any tendency to turn out or to rock, and enter the station with perfect smoothness and regularity. The entrance and exit of passengers at the stations is effected without loss of time, as the guard presses a stud the doors are locked automatically. The distance is covered in 12—13 minutes. The speed will, however, be still further increased at an early date. Tickets are supplied by automatic machines (10 pf. for first-class two tickets), and are punched by the guards travelling with the cars. At the termini the cars are transferred over loop lines to the other rails in a few minutes. It is asserted that the question of dealing with the traffic in this district, which had become more and more acute during the last few years, has been most satisfactorily solved by the ingenious system of the contractors, the well-known Schuckert Company.

Barrow.—The Corporation and the British Electric Traction Company, the owners of the tramway system, have now agreed to terms. The company's offer to lay down a complete electric service if the Corporation would give them a long lease has been accepted, and the Corporation have decided to grant a lease for 28 years, the company to substitute electricity for steam, and receive their electric current from the town's supply. The conversion will cost the company £65,000.

Birkenhead.—The T.C. has decided to double the new electric car track in New Chester Road between Green Lane and St. Paul's Road, and that application be made to the Board of Trade for sanction to borrow £5,103 for carrying out the work. The Tramways Committee have decided to provide rubber gloves for use on the electric tramways in case of emergency.

Central London Railway.—The committee appointed to inquire into the alleged damage to property resumed its sittings on Monday at the Board of Trade, Whitehall. A good deal of evidence relating to the question of vibration was given by Mr, Maurice Powell, of No. 2, Kensington Palace Gardens, the town clerk of Holborn (Mr. H. C. Jones), Mr. C. FitzRoy Doll, and Mr. George Nash, manager to Messrs. Marshall & Elvey. The chairman (Lord Rayleigh) addressing Mr. Basil Mott, the engineer, said some of the witnesses had stated that they felt the trouble more in the time of heaviest traffic. Prof. Ewing suggested there might be a difference of speed in various parts of the day. Mr. Basil Mott said there was no difference of speed, but the trains were more numerous in the morning and evening. At the busiest time of the day the trains were about 2 minutes 50 seconds apart, and in the slackest 3½ minutes. Mr. Mallock said that his observations showed that nine out of every ten trains would be going at the rate of 20·5 miles an hour, and the tenth at the highest speed of 22 miles. Mr. Basil Mott, in reply to Prof. Ewing, said he had examined the road and the rolling stock, and had found nothing that would account for the alleged increased vibration. The committee adjourned.

Dudley.—Negotiations are now proceeding with the object of bring the whole of the six tramway lines that converge at Dudley to a joint terminus in Dudley Market Place.

France.—The working of the recently constructed lines of the electric tramway of Cette are giving every satisfaction, and the company has decided upon the construction of a new line and three extensions.

Ealing.—Mr. Clifton Robinson, managing director of the London United Tramways, Limited, writing with regard to the Ealing and Brentford extensions of the company's lines, suggests to the Ealing U.D.C. that the Council should give its formal consent to the company's proposals, subject to withdrawal if unable to agree on clauses, and the company also offer to construct the lines at times and in sections to suit the Council. The letter was referred to committee, who are understood to be favourable to the company's suggestions.

Germany.—Under this title our contemporary the *Elektrotechnische Zeitschrift* has just published, according to its custom at this time of the year, a report on electric traction in "the Fatherland" up to September 1st of the preceding year. Without entering too minutely into details, we give a few figures that are both interesting and instructive. Electric traction has up to the date mentioned, been installed in 99 German cities and towns; the total length of the street served is 2,868 kilometres; the total length of lines laid is 4,254 kilometres; and the number of motor car reaches the respectable total of 5,994; while the travellers are represented by 3,962. The total force utilised by electric traction is 92,498 kw.—dynamos, 75,608 kw.; and accumulators, 16,890 kw. Berlin boasts of 42 lines, Dresden 24, and Leipzig 20. The following are a few comparative figures:—

	1899.	1900.
Passengers carried	79,924,000	91,922,000
Receipts	12,937,000	12,942,000
New lines	83·9	56·78
Passengers per day per kilometre ..	2,415	2,910
Density of traffic per car-kilometre ..	740	783
Expenses (in marks)	600,000	800,000

Glasgow.—Two sections of the newly-equipped electrical system were successfully tested on 13th inst., viz., Whiteinch to Dalmarnock and Crosshill to Overnewton. Current was obtained from the present Springburn station, the new high tension supply station at Pinkston not yet being in a sufficiently advanced state to supply current. In connection with overhead equipment the Town Council have now decided to finish Great Western Road with sides poles instead of centre poles, viz., from Hyndland Road to Anniesland Toll, a distance of about 1½ miles. A complete telephone installation is to be fitted between the supply stations and the feeder boxes on the streets, some 900 instruments being required. The Council have offered a premium for an approved method "which will keep the outside seats on their cars dry during rain without the use of waterproof rugs."

Heston—Isleworth.—A letter is before the U.D.C. from the London United Tramways, Limited, announcing that they had decided to strike out from their Bill the lines in the Council's district in consequence of a demand made by the clerk for the payment of costs.

Huddersfield.—The income from the electrically-equipped routes from February 14th to 28th amounted to £569 6s. 1d., or 9·14d. per month per car-mile. The Linghwaite and Longwood sections did not begin to run until March 21st. For the above period the expenditure was £1,118 17s. 1d.

As an experiment the Huddersfield Corporation has resolved to establish uniform fares inside or outside for three months from April 1st for their electric and steam cars. The scale is under 1d. per mile.

Italy.—The Mediterranean Railway Company has decided upon the electric equipment of their line between Milan and Gallarate with its bifurcations in three different directions towards Lakes Majore, Varese, and Lugano to the towns of Arona, Laveno, and Porto-Ceresio. The length of the line from Milan to Gallarate is 40 kilometres, and the three branches 26, 32, and 33 kilometres respectively. The current will be collected on the third-rail system. The rolling stock will comprise 20 motors and 20 trailers. The former will be capable of carrying 75 passengers and the latter 93.

Lancashire and Yorkshire Railway.—The statement to the effect that the Lancashire and Yorkshire Railway Company are about to adopt an electrical system of working its lines between Manchester and Bolton is contradicted by the officials—at any rate, so we read in a Manchester paper. The chief engineers of the company have, however, just concluded a visit to America, where that problem has been studied amongst other systems in vogue across the Atlantic.

Light Railways.—The Board of Trade has recently confirmed the following light railway orders:—(1) West Hartlepool Light Railways (Deviations, &c.) Order, 1901; (2) Ormskirk and Southport Light Railways Order, 1901; (3) Kelvedon, Tiptree, and Tollesbury Light Railway Order, 1901; (4) Morley and District Light Railways Order, 1901.

Liverpool.—On Wednesday last week, in the County Court, Messrs. Perry & Co., herb beer manufacturers, of Liverpool, claimed £50 as damages from the Corporation for injury to a horse and lorry and loss of stock through collision with an electric tramcar on October 29th last. After a protracted hearing the jury found for the plaintiffs and assessed the damages at £25. Judge Collier gave judgment for this amount.

Manchester.—The Electricity Committee on 12th inst. passed a resolution requesting Dr. Kennedy, the electricity expert, to erect a temporary generating station at Stuart Street, Bradford, with the object of providing for the running of electric tramcars over the whole of the routes in the city in the summer of 1902. The plan decided upon will enable the Corporation to meet its obligations to outside authorities as well as the Tramways Committee in respect to the working of the tramways.

Metz (Lorraine).—The town of Metz has decided upon the construction of an electric tramway. It is proposed to establish a five minutes' service inside the town, while in the suburbs the cars will run every 10 or 20 minutes.

Middleton.—Major Druitt, Board of Trade inspector, last week held an inquiry into the T.C.'s application to borrow £37,500 for the construction of tramways as authorised by the Middleton Corporation Tramways Order, 1900. The inspector at the close stated that he should have great pleasure in recommending the application for sanction.

Municipal Tramways.—In the House of Commons last Friday Mr. J. W. Lowther proposed to alter Standing Order 134 C, so that when any Bill enabling a municipal corporation to construct a tramway outside its own district is submitted to a Committee, the Committee may for as much as 42 years protect the corporation from being bought out by the local authority through whose area the line is to pass. The present period is 21 years, but Mr. Lowther explained that it was adopted when there were no electric tramways. Those means of locomotion, it was found, lasted sometimes 42 years, and unless municipal corporations were enabled to keep them that length of time, those bodies would not be encouraged to construct them. The motion was agreed to.

Newcastle-on-Tyne.—Eleven miles of track are now completed; 35 new cars, costing £20,725, are on order. The contract for tanks at the generating station has been given to Messrs. Smith, Patterson & Co.

Paisley.—The T.C. have discussed the advisability of withdrawing their opposition to the Paisley and District Tramways Bill, but by a vote, 16 to 5, they have decided to go on with the opposition.

Peterborough.—The British Electric Traction Company have asked an interview with the T.C. on the subject of a supply of motive power, the company being anxious to make their plans for the commencement of the proposed electric trams. The matter came before the Council on the 15th inst., when it was decided to invite the representative of the company to an interview.

Richmond (Surrey).—A public meeting, convened by the Richmond Tradesmen's Association, was held on the 14th inst. when Mr. J. Clifton Robinson, managing director to the London United Tramways, Limited, explained his scheme of tramways affecting the borough. The company were willing to spend £30,000 on widening the Kew and Sheen Roads, pay the Corporation £500 per annum, use wood paving and give the Corporation the option of choosing between the conduit and overhead trolley systems. Within the borough there would be a uniform 1d. fare, and cars for the industrial classes at reduced fares. A resolution favouring the scheme was approved.

St. Petersburg.—A report on the study of the proposed metropolitan railway of St. Petersburg has just been submitted to the commission appointed to consider the project. It is proposed to construct a circular line with bifurcations, of normal gauge, to be worked electrically and built on embankments and viaducts. The estimated cost for the entire system is 190 million roubles. A revenue of 1½ per cent. is anticipated on the first year's working, and 5 per cent. after 10 years.

Salford.—The authorities, says the *Manchester Evening News* in a lengthy and interesting article, both in the tramways and electric departments are vigorously pushing forward the work of completing the tramway system for the purpose of running it with electric energy. Twelve miles of single track have been laid, and 450 men are employed during the day and in some cases at night. In the use of cement for the foundations the Corporation have been more lavish than their Manchester neighbours, but have not gone to the same expense as the Liverpool authorities. The article speaks in highly complimentary terms of the ceaseless care and supervision of Mr. Alderman Linsley, the chairman of the Tramways Committee, and Mr. Ernest Hatton, the engineer and general manager of the tramways system. The new generating station will be in Frederick Street, close to the Pendleton Baths, which will supply all the power requisite for the propulsion of the cars. Although not likely to be ready for some months, the plant is being fixed as space permits. Lower down is the car shed, providing accommodation for 180 cars of the double-decked type, seating 45 persons, 20 inside and 25 out. The Corporation will take over the tramways portion of the Carriage Company's undertaking on April 28th next. The first route to be opened will be that from Pendleton to Victoria Bridge, and the drivers and conductors will be taught the new system in relays. The design of the Salford poles is rather more ornate than usual.

Shoreham.—The Shoreham and Hove Tramway Company is conferring with a number of local authorities, so as to know their requirements for electric trams before applying for powers.

Sunderland.—The Finance Committee is applying for a loan of £31,000 for tramway purposes.

Tynemouth.—An electric tram service was inaugurated on Monday by thousands. The new line, which is worked on the overhead system, reaches from North Shields to Whitley, three miles away. The cost, up to the present, has been about £60,000.

Underground Railways.—The Brompton and Piccadilly Circus Railway Company has, says the *Financial Times*, complied with a decision of the Standing Orders Committee of the House of Lords by withdrawing from its Bill the whole of its proposed extensions with the exception of about 6 furlongs between Piccadilly and Bloomsbury Square. The total length of the abandoned extensions is just over 3 miles 5 furlongs, which included the proposed extensions to Islington and to Chelsea. Owing to this important amendment in the Bill the estimated expenditure by the company on these extensions is reduced from £1,569,689 to £334,944.

The newspaper press is publishing detailed statements to show that Mr. C. T. Yerkes has obtained possession of the controlling influence in the Metropolitan and District underground lines.

In the House of Lords on 15th inst. the Charing Cross, Hammersmith and District Electric Railway Bill and King's Road Railway Bill were read a second time.

Wednesfield.—The U.D.C. is sending a deputation to the Wolverhampton Corporation Tramways Committee to see if the electric tramway which is to terminate in Heath Town can be extended to Wednesfield. This, it was stated, would be a great public convenience to Wednesfield and to Wolverhampton.

West London.—The *Times* of 18th inst. contained the following from a correspondent:—"The Board of Trade inspection of the electrical equipment of the West London tramways was carried out on Friday afternoon by Mr. A. P. Trotter, the Board's electrical adviser. For an hour or two the ordinary horse-car traffic was entirely suspended, and the line between Hammersmith and Kew Bridge given up to the electrically-driven cars, of which in all 30 were in operation. At the same time Mr. R. T. Glazebrook, on behalf of Kew Observatory, was watching the measuring instruments in the generating station at Chiswick, and noting particulars of the power put into the line. The data thus obtained will be compared with the readings of the magnetometers at Kew for the same period, in order to ascertain what effects, if any, are produced by the running of the electrical cars, and whether the latter give rise to any disturbances in the records in addition to those already noticed as a result of the Central London Railway or of other causes. If no additional disturbances are detected, and provided that the report of the Board of Trade's inspector show him to be satisfied with the electrical arrangements—a point as to which there need be little doubt—there is no reason why the public electrical service should not start immediately on the sections of the system that are now ready. If, on the other hand, the instruments at Kew are found to be injuriously affected, it will be necessary for an agreement to be reached between the Kew authorities and the company which owns the tramways, as to the amount to be paid to the former to enable the instruments to be set up in some more suitable location than Kew. It is to be hoped that some *modus vivendi* will quickly be arranged between the two parties, not only on account of the company, which is being debarred from getting any return on the large sums it has sunk in converting its lines to electrical traction, but also in the interests of the public, who are prevented from enjoying the increased facilities for locomotion which the electrical cars will provide."

Wolverhampton.—A deputation from the Corporation Tramways Committee is this week visiting Paris for the purpose of inspecting a new conduit system of traction there. This system has been reported upon very favourably, and the Committee think it might prove more advantageous for Wolverhampton than the overhead method of traction. Mr. T. Parker, of Wolverhampton, electrical engineer, accompanies the deputation to give expert opinion.

TELEGRAPH AND TELEPHONE NOTES.

Beckenham Telephones.—The Works Committee of the Beckenham Urban District Council are considering the following resolution, recently forwarded by the Bromley Urban District Council:—"That all the parishes in the Bromley Union be asked to unite with this Council in approaching the General Post Office, with a view to an installation being commenced by them in this district at the earliest possible moment."

British Cable Operators.—A cable dispatch from Halifax, N.S., says:—"It is reported from the French island of Miquelon that the French administration has given the English cable operators, whom it has imported to operate the submarine lines ending at Miquelon, their choice of taking the oath of allegiance to France or resigning their jobs. Most of the men have done as was demanded rather than quit." "But their hearts are true to Poll."—*Electrical World* (New York).

Canadian Telegraphs.—The *Financial Times* says:—"There are several newspaper reports in Canada to the effect that the Government is negotiating for the purchase of the telegraph lines, with a view to conducting this business."

East Suffolk Telephones.—The East Anglia Telephone Company has applied to the East Suffolk County Council to grant it facilities for erecting wires in East Suffolk. It appears that the company purchased the plant of a man who started a telephone system at Southwold and the neighbourhood. Certain facilities were offered by the Post Office, and the East Anglia Company was taking advantage of them.

Eastbourne Telephones.—In reference to the appointment of an expert (Mr. A. R. Bennett) to report as to the cost of a municipal telephone exchange for Eastbourne, and its probable extension over the area covered by the Parliamentary division, a

conference is to be held, to which the various local authorities (urban and rural) have been invited to send delegates, to discuss the exact district to be included in the exchange area.

The Ownership of Cables in Troubled Waters.—On Monday last Sir Charles Dilke raised the following question in Parliament:—Whether the cable recently laid between Shanghai, Wei-Hai-Wei, and Taku (other than the portion between Wei-Hai-Wei and Chefu shown in the Estimates), has been laid by arrangement with his Majesty's Government, and to whom it belongs: And whether, in case the proprietorship of the cable is divided between the Eastern Extension Telegraph Company and the Great Northern Telegraph Company, the nationality of the persons employed in the offices at Shanghai, Chefu, Wei-Hai-Wei, and Taku has been provided for in the agreement; or whether, the Great Northern Company being the Danish company which uses the Russian land lines as part of its system, the new cable is subject to the same arrangement as those which have previously existed with regard to the offices in China of that company.

In reply, the Chancellor of the Exchequer said the cable between Shanghai, Chefu, and Taku (which does not touch at Wei-Hai-Wei) has been laid by the Eastern Extension and Great Northern Telegraph Companies on account of the Chinese Telegraph Administration under an arrangement which his Majesty's Government recognises and supports. The cable is mortgaged by the Chinese administrations to the companies for 25 years at least, and they will work and maintain it. Wei-Hai-Wei will be served by a branch line from Chefu. It is stipulated in the agreement between the Eastern Extension Company and his Majesty's Government that the branch line shall be worked by a British staff, and that all traffic between Wei-Hai-Wei, Chefu, Shanghai, and Hong-Kong shall also, as far as practicable, be transmitted exclusively by a British staff.

Proposed New Cable.—The Hon. W. Mulock, Canadian Postmaster-General, who is now in London, is stated to be actively interesting himself in a project to run a direct cable between Canada and the United Kingdom.

Russo-German Telegraphs.—The *Times* Odessa correspondent writes:—"The announcement is made that a new line of telegraph is shortly to be constructed between Odessa and Berlin. Telegraphic communication between England and India is at present conducted over the existing Berlin-Odessa line, while London wires for East India and Southern Asia are sent to Berlin, thence to Odessa, and on to their destination *via* Teheran, but in consequence of the difficulty experienced in working such a huge stretch of line a transforwarding station had subsequently to be set up in Odessa. During the last few years the number of telegrams passing between Odessa and Berlin alone has increased to such an extent that it has been found impossible to get through the work satisfactorily without a supplementary line."

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
St. Louis (Senegal)-Bathurst	Aug. 25, 1900	
Pará-Maranham	March 1, 1900	
Latakia-Cyprus	June 20, 1899	
Marseilles-Barcelona	Jan. 7, 1901	
Fao-Bushire	March 7, 1901	
Landlines:—		
South American—Communication with Cartagena and Baranquilla	Dec. 8, 1900	
Chinese—Tientsin-Pekin	June 11, 1900	
Pekin-Kalgan	June 14, 1900	
Kalgan-Maimatchin	June 30, 1900	
Tientsin, *via* Shanghai	June 16, 1900	
Tientsin and Taku *via* Helampo	June 18, 1900	
All lines connecting Cochin China with Thuanan	Oct. 23, 1900	
Communication "*via* Hanekine" interrupted on Persian territory	Feb. 26, 1900	
Moulmein-Bangkok	Feb. 28. 1901	
Saigon-Bangkok	March 13, 1901	March 19

Telephone Wires at Manchester.—The City Surveyor has presented an important report to a meeting of the Special Committee which has been formed to consider the question of dangers arising from telephone wires passing over trolley wires used in running electric trams. He stated that 7,798 telephone wires pass over the existing tramlines in the city, and 3,781 over intended tramlines. There are also in the city about 60 miles of telephone wires laid under the public streets. These are in cables running from the Telephone Exchange in Portland Street to buildings in each local area where subscribers are situated. Each cable is opened out on the top of a building in a local area into overhead wires connecting to the nearest chimneys or corners of surrounding buildings in which subscribers were located. The best method of dealing with the overhead telephone wires would be to sub-divide the distributing areas by laying short lengths of underground service pipes from the nearest existing underground cable route to smaller distributing areas off the main thoroughfares. By this arrangement the wires crossing the tram routes would be no longer required, as the telephone instruments would be served by short distributing wires in self-contained areas and cross minor streets only. The overhead cables were, of course, insulated, and contained about 104 wires each. Assuming that the insulation was perfect in every case, the danger due to these cables would be minimised. The danger from postal telegraph wires passing over tramway routes would be reduced by enclosing them in insulating cables. A long discussion took place on the report, and it was decided that the town clerk should be asked to prepare a report showing the position of the Corporation under the Telephone Act, 1899, and the agreement with the National Telephone Company.

Wireless Telegraphy.—In the House of Commons last week, Mr. G. Balfour, in answer to Sir R. Penrose Fitzgerald, said that certain stations were being erected by the Admiralty along the coast to test the value of wireless telegraphy.

CONTRACTS OPEN AND CLOSED.

OPEN.

Amsterdam (Holland).—April 1st. The Communal Council will on this date consider tenders for the supply and erection of all the motors necessary, and the installation of the electric lighting of the power station, switchboards, &c. Conditions from the Municipal Printing Office, 10 florins (16s 8d.). Information from the manager of the office of Electricity, Achterburgwal, 213, Amsterdam.

Aylesbury.—April 22nd. The U.D.C. wants tenders for establishing and maintaining electricity works. See "Official Notices" to-day.

Bradford.—April 3rd. The Corporation wants tenders for a combined motor balancer and boosters, with switch gear for same. See "Official Notices" to-day.

Brussels.—The Belgian State Railways will shortly consider estimates at the Brussels Bourse for the supply in 20 lots of various objects for electric lighting. Particulars from the Service de la Traction et du Materiel, Belgian State Railways, Brussels.

Burnley.—March 23rd. The Tramways Committee wants tenders for overhead equipment for electric tramways. See "Official Notices" March 1st.

Burnley.—March 23rd. The Tramways Committee wants tenders for rail bonds and cables. See two "Official Notices" March 8th.

Buxton.—March 23rd. The Council wants tenders for an electrically-driven triplex pump (17 H.P.). See "Official Notices" March 8th.

Christiania.—March 30th and April 6th. The Secretary of State for Foreign Affairs has received a despatch from his Majesty's Consul-General at Christiania stating that tenders are invited by the Norwegian State Telegraph Department, not later than noon on April 6th, 1901, for the supply of telegraph wire, bronze wire, and telephone cables. The Secretary of State has received another despatch from his Majesty's Consul-General at Christiania, stating that tenders are invited by the Norwegian State Telegraph Department, not later than noon on March 30th next, for the supply of porcelain insulators, iron angles, brackets, top coverings, top plates, and telephones. Particulars may be seen between 12 and 1, at the Technical Department of the Telegraph Office in Christiania.

Colwyn Bay.—March 22nd. The U.D.C. wants tenders for one 120-KW. steam dynamo, and switchboard extensions. See "Official Notices" March 8th.

Dublin.—April 22nd. The Lighting Committee wants tenders for condensing plant, pipework, feed pump, superheaters, mechanical coaling apparatus, crane, and workshop equipment. See "Official Notices" to-day.

Farnworth.—March 29th. The U.D.C. wants tenders for electricity meters. See particulars in our "Official Notices" to-day.

Gorton.—March 22nd. The U.D.C. wants a supply of electricity for its district for lighting, for 5, 7, 9 or 12 years. See "Official Notices" March 8th.

Gravesend and Northfleet.—March 25th. The B.E.T. Co., on behalf of the Gravesend and Northfleet Electric Tramways Company, wants tenders for the construction of new tramways and reconstruction of existing lines, and for the supply of electrical equipment. See "Official Notices" March 8th.

Halifax.—March 26th. The Corporation wants tenders for telephone and other cables. See "Official Notices" March 15th.

Holland.—March 25th. Tenders are being invited until March 25th next by the municipal authorities of Amsterdam, for the equipment of a central electric lighting station in the city.

Hornsey.—April 11th. The U.D.C. wants tenders for dryback boilers, pumps, economiser, 300-KW. steam dynamos, motor transformers, condensing and water cooling apparatus, pipework, switchboard, battery, crane, mains, arc lighting, meters and workshop equipment, &c. See "Official Notices" March 15th.

Kirkcaldy.—April 15th. The Corporation wants tenders for two 80-I.H.P. and three 250-I.H.P. engines and continuous current dynamos, storage battery, and 15-ton crane. See "Official Notices" March 15th.

Launceston (Tasmania).—April 22nd. The Corporation wants tenders for the supply of 500 electric meters. See "Official Notices" January 11th.

(*Continued on page* 505.)

THE GENERATION AND TRANSMISSION OF ELECTRIC ENERGY AT AND FROM COAL PIT CENTRES.

By B. H. THWAITE, C.E.

(*Continued from page* 396.)

Lancherthal—Sigmaringen.—This is a continuous current example. The electrical force is generated by a 182-H.P. water-power turbine at Lancherthal. The turbine revolving at 115 revolutions, drives by belting, two continuous current dynamos; another machine is provided as an auxiliary reserve. The dynamos (400 revolutions) generate current at 1,100 volts.

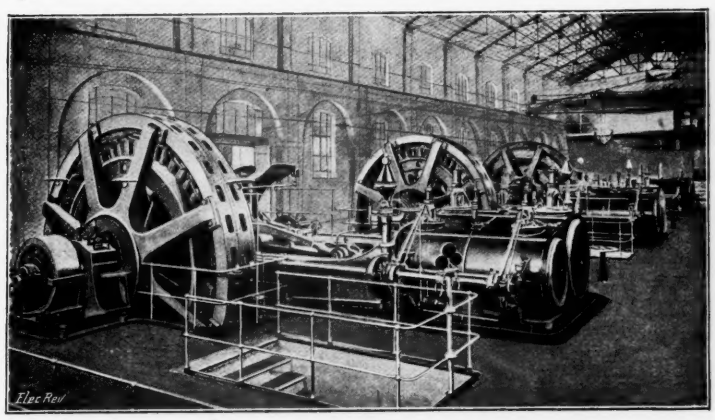


Fig. 1.—Porta Volta Central Station, Milan.

The energy from each electrical generator is united by the three-wire system, and is transmitted a distance of 5 kilometres to a transforming station in the town of Sigmaringen.

The transforming station is equipped with three continuous current transformers as well as with a battery of accumulators. Each transformer consists of a main current motor and a shunt dynamo—having a common shaft and revolving at 400 revolutions per minute.

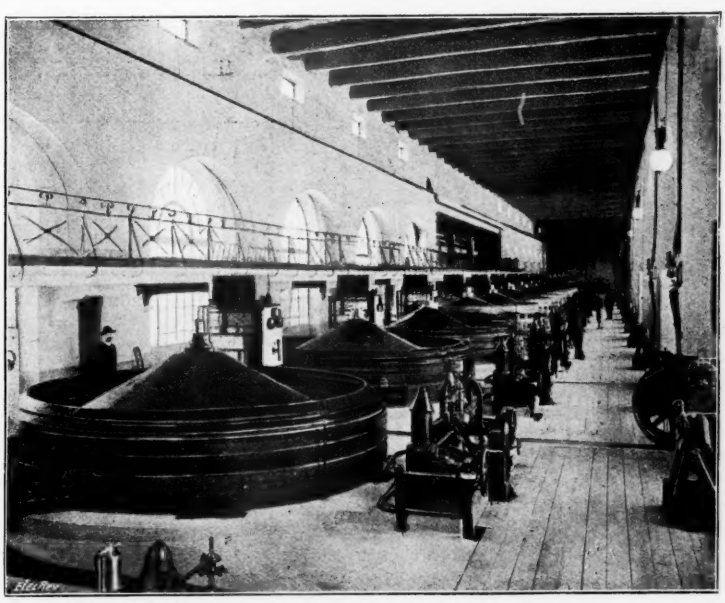


Fig. 2.—1,200-H.P. Two-phase Alternators in Chèvres Electricity Works.

Tivoli—Rome.—The 18 miles electric energy transmission installation transmitting current from ancient and beautiful Tivoli, with its famous aqueducts, to the capital of Rome, was fully described in the author's 1892 paper; this pioneer Italian installation has been in steady operation for over 10 years, with a line pressure of 5,000 volts, and no serious trouble has interfered with its uniform success.

In France, the Force Motrice Company has already installed eight 1,250-H.P., 3,500-volt three-phase generators, and these have been in operation over two years, for the supply of power to factories in the environs of the generating station.

At the works of the Oerlikon Company, Oerlikon, Switzerland, the power is obtained from a generating source 14 miles away. The energy (three-phase) is transmitted at a pressure of 14,000 volts to the works most efficiently.

In England, with the exception of the well-known Deptford installation, practically nothing has been done to merit particular attention, but the initial years of the new century will probably be witness to a development of the principle of power generation at the coal pits and its distribution, that will surpass similar enterprises elsewhere; further reference will be made to the scope of the Power Supply Companies Parliamentary defined areas.

The distribution of electric energy for satisfying the requirements of electric railways, although in a condition of initial evolution, promises developments of a strikingly interesting character. It is proposed to lead the high pressure current to the trains, on which, and only then, will the transformation to the desirable voltage be effected; this policy will mean a considerable economy, because over the maximum distance of any line the transmission will always be effected at high and economic line pressures.

The Engelberg-Zermatt Railway in Switzerland.—Three-phase alternators supply energy to induction motors on the locomotives; the equipment of the latter is made up of two 75-H.P. three-phase motors.

On downward gradients gravitation is utilised on this railway; the motors, when the train is descending stiff gradients, become generators, and actually supply energy to other trains—the electric energy thus generated is sometimes in excess of the railway demand and has to be dissipated by water resistances. The speed possibilities of the three-phase induction motors applied to each axle, are only limited by the structural appropriateness of the permanent

way and its rolling stock. Railway speeds of over 100 miles an hour, whether on single or double rails, are likely to be adopted on main or trunk railways. The author has already in the 1892 paper, and more recently in the *Engineering Magazine*,* explained the economic *raison d'être* of trunk railway electric traction.

The economic possibilities of the principle have recently been dealt with by an official of one of our great railways, and they are of such an important character as to arrest the attention of the most fossilised adherent to the miserable thermo-dynamic inefficiency of the reciprocative steam locomotive.

The Influence of the Success of the Three-phase Alternator. — Probably the real explanation of the remarkable spread of high pressure electric energy transmission in Europe and America is the splendid and solid success of the three-phase alternator and its electric energy product.

Fig. 3.—Exterior of Generating Station at Marbach.

As an example of its practical use and advantages for transmission purposes, one can refer to the Kander installation, comprising some 600 kilometres of wire transmitting alternating current at a pressure of 16,000 volts. The electric power house on the Kander was illustrated in the Electrical Review of October 12th, 1900.

The facile way in which this pressure can be lowered for factory distribution has brought about a wonderful simplification, and the highest perfecting of the design of three-phase low pressure armature windings. In place of the delicate *wire-wound* character of these motors, involving constant repair and a heavy rate of depreciation, that reduced considerably the advantage of this system, and especially for traction work, a *solid* system of construction is used, in which solid *bar* windings displace the wire, and the motor machine is now thoroughly substantial, and is in addition the acme of simplicity.

The remarkable simplicity and effectiveness of oil switch and controlling gear has contributed not a little to the popularisation of high pressure distribution work, and a modern electric power distribution plant equipped by either Brown-Boveri, Schuckerts, the General Electric Company of Berlin, or by the Fabrik Oerlikon, will leave little margin for improvement; all the requirements of rough every-day work have been, with more or less perfection, adequately met.

The range of applications of the high pressure alternating system is widening daily, but already it is most comprehensive; the fact that the simplicity of the equipment has removed the necessity of the supervision of skilled electricians has not been without its effect in securing the widening patronage of high pressure alternating systems coupled with alternating current motors. The motors are now in every day use, driving centrifugal machines, lifts and elevators, ventilators and fans, self-acting and ring spinning frames and weaving looms, jib and travelling cranes, traversers, rolling and wire drawing mills, plunger pumps, rotary pumps, automobiles, locomotives.

Fig. 1 is an interior view of the Porta-Volta central station in Milan, generating three-phase alternating current at 3,600 volts line pressure. Fig. 2 illustrates the interior of the central station at Chèvres, near Geneva, generating two-phase current at 5,000 volts line pressure. Figs. 3 to 7 show views of the Marbach and Prag generating and transforming stations, which were briefly described in the preceding article. Fig. 8 and fig. 9 show latest design three-phase alternating and induction motors produced by the Maschinen Fabrik Oerlikon.

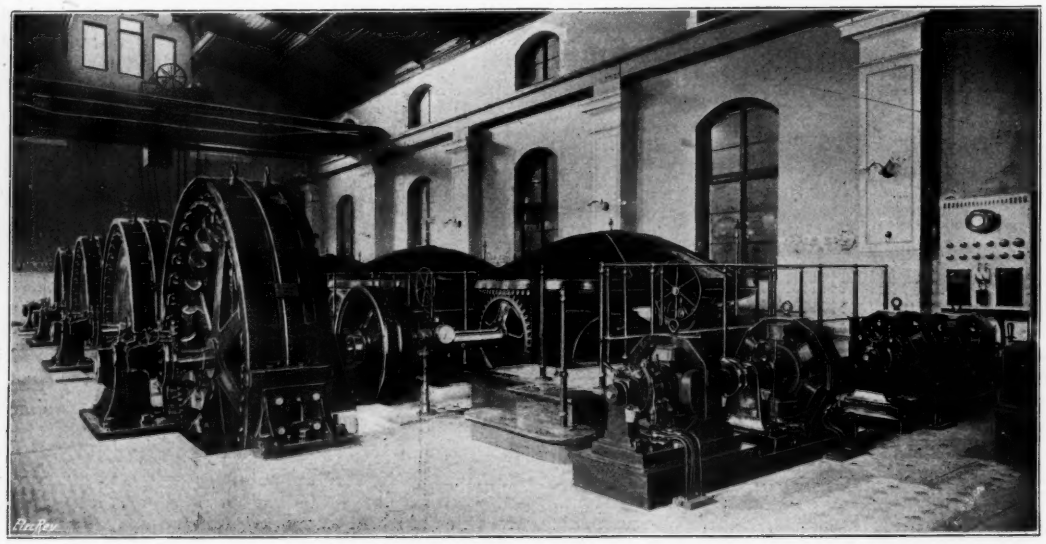


Fig. 4.—Interior of Generating Station at Marbach.

* "The Influence of Electricity upon Railway Locomotion," *Engineering Magazine*, June, 1899.

The Widening Field of Industrial Application.

Aluminium.—Schaffhausen, famous for its early pioneer work in long-distance electric transmission work, is also celebrated for the production of aluminium by electrolysis.

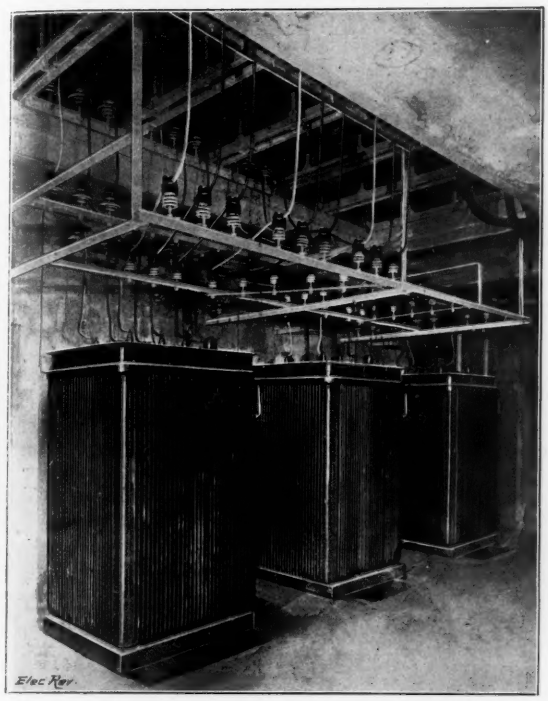


Fig. 5.—Transformers at the Prag Sub-station.

Faraday had little conception when he visited Schaffhausen in the early years of last century as the companion of Humphrey Davy that the picturesque village would be the scene of one of the most promising applications of his discoveries in electric generation, and relating to the influence of electricity in effecting changes electrolytically; this influence Faraday's consummate skill as an investigator had also unravelled. Strangely enough, the product of electrolytic action promises to be a most valuable agent for effecting the economic transmission of electric energy. The process is the electrolysis of aluminium dissolved in fused cryolite, the object being to obtain the metal aluminium.

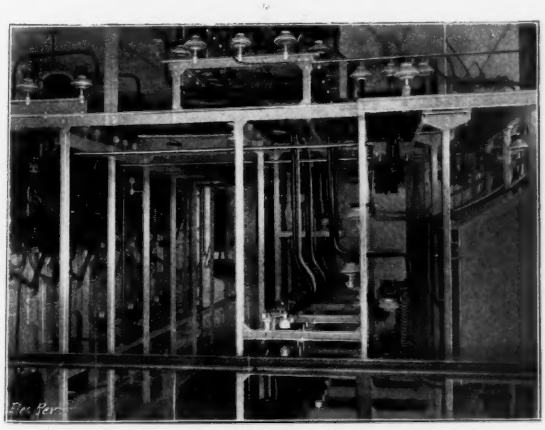


Fig. 6.—Switch Gear at the Prag Sub-station.

Phosphorus.—Phosphorus is produced by distilling a mixture of phosphate of lime and alumina with coke.

Carborundum.—Produced by the fusion in an electric furnace of a mixture of sand and coke. The product, a compound of carbon and silicon, has already been welcomed into many factories. Its value, so far, is found in its excellent polishing qualities.

Soda and Chlorine.—Both these agents, of such great utility for many of our staple industries, are now being produced by electrolytic effects. There are several processes in operation, but that known as the Castner-Kellner is illustrative of the principle, consisting in the decomposition of a solution of chloride of sodium (common salt) by the passage through it of electric energy. The salt solution is placed in rocking trays, one of the electrodes being mercury. The electrical dissociation sets free the chlorine in a gaseous form, leaving the soda in solution as a more or less pure hydrate.

Cyanide of Potassium. — Thanks to McArthur and Forrest, this chemical agent, used in a most dilute form, has enabled a great part of the gold still remaining in the residue from the gold ore crushing stamps, and known as tailings, to be economically recoverable. Cyanide of potassium has consequently attained a high position amongst the agents of industry. The process is too complex to admit of brief description.

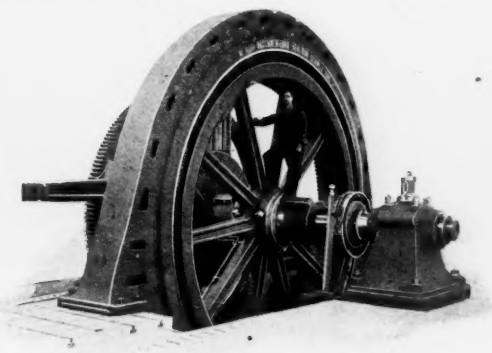


Fig. 8.—Three-Phase Synchronous Motor. (Oerlikon.)

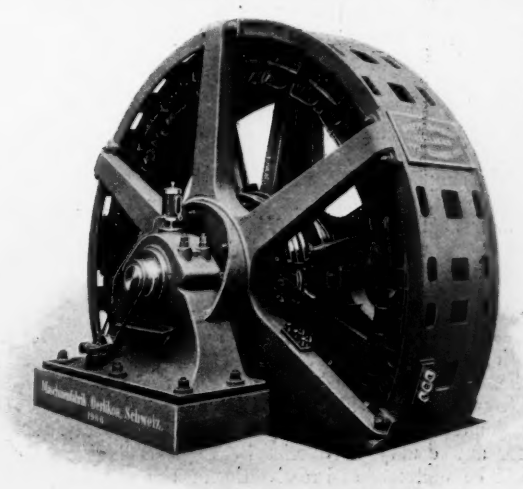


Fig. 9.—Three-Phase Induction Motor. (Oerlikon.)

Electro-deposition of Copper.—The production of chemically pure and high conductivity copper by electro-deposition is an important industry. The same process, now commercially very economic wherever electric energy is obtainable at reasonable rates, is applicable for silvering and gilding.

Electro-fusion Processes.—Moissan has obtained strikingly valuable effects by his high temperature electric crucible furnace; his results include minute examples of carbon in diamond form.

The author has melted steel in crucibles under a reducing atmosphere of CO; once electric energy is obtainable at reasonable prices in bulk, it will be economically possible for every ironfounder within the area of electric supply to produce his own steel castings up to a certain weight.

Calcium Carbide.—This product is a direct sequel to the possibility of producing exceptionally high temperatures, by which a chemical and fused combination between lime

and carbon is possible. This compound, known as calcium carbide, when brought into contact with water, evolves a highly combustible gas known as acetylene.

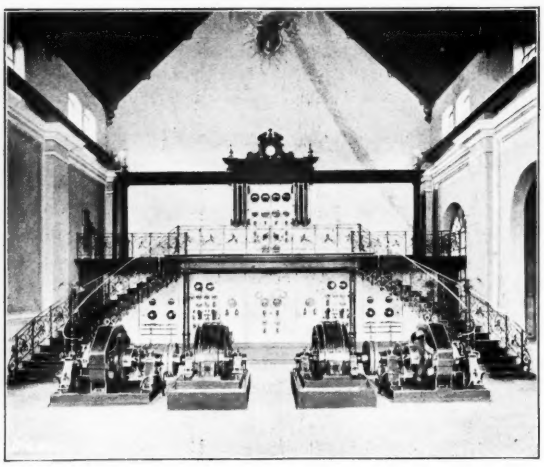


Fig. 7.—Motor Generators in Sub-station at Stuckach.

In Germany, alone, some 15,000 tons of calcium carbide are said to have been produced last year. This is equivalent in light-producing power to the production of 2,700 millions of cubic feet of retort lighting gas. Electricity may be said to have produced a gaseous illuminating agent that will surpass its old rival—retort gas. This agent, acetylene, provides a light of hygienic excellence, and of remarkable luminous beauty. It is not necessary to lengthen this long record,* indicating the widening scope of the field of application. Enough has been written to demonstrate the enormous value of the electric agent, which, whilst producing power and light, provides the means to produce new and valuable industrial objects.

The simplicity of the electric generating agent, is such that if properly armour-clad and dust-proof, it will work for years with little depreciation other than that due to frictional effect.

The Electric Transmission of Power in the United Kingdom.

The declaration of the Parliamentary Committee appointed to examine the Electric Power Bills is a sufficient indication that any rationally designed project for any county or district in England will be welcomed and receive the sanction of Parliament. The only one of the several power schemes applied for that did not receive Parliamentary sanction was that to provide the Tyneside with power; the overlapping of this scheme with existing rights probably explains the refusal of the Committee to permit the Bill to pass.

The following is a list of the electric power supply areas for which Parliamentary sanction has been obtained (see map, fig. 10):—

The Lancashire Electric Power Supply Company.—This Bill excludes from its operation the towns of Liverpool, Bootle, Manchester, Salford and Stockport; with these exceptions the Bill covers the entire area — about 1,000 square miles — of Lancashire situated south of the river Ribble.

South Wales Electric Power Distribution.—This Bill includes in its operation the entire area of the county of Glamorgan, and also that of Monmouth as far as it extends to the river Usk, including the town of Newport. The area comprised in the scope of the Bill equals 1,050 square miles, and in its operation it includes the provision of the right of electric power to Cardiff, Newport, Swansea, Barry, Merthyr, Pontypridd and Neath. It will be realised by those who know the industrial characteristics of South Wales that this Bill includes the satisfaction of the colliery, shipping, and iron and steel manufacturing districts. The Bill gives the promoters the right to supply electric energy to any person for power purposes unless in any area for which sanction had already been obtained, but even this area can be entered by the Supply Company if reference is made to the Board of Trade.

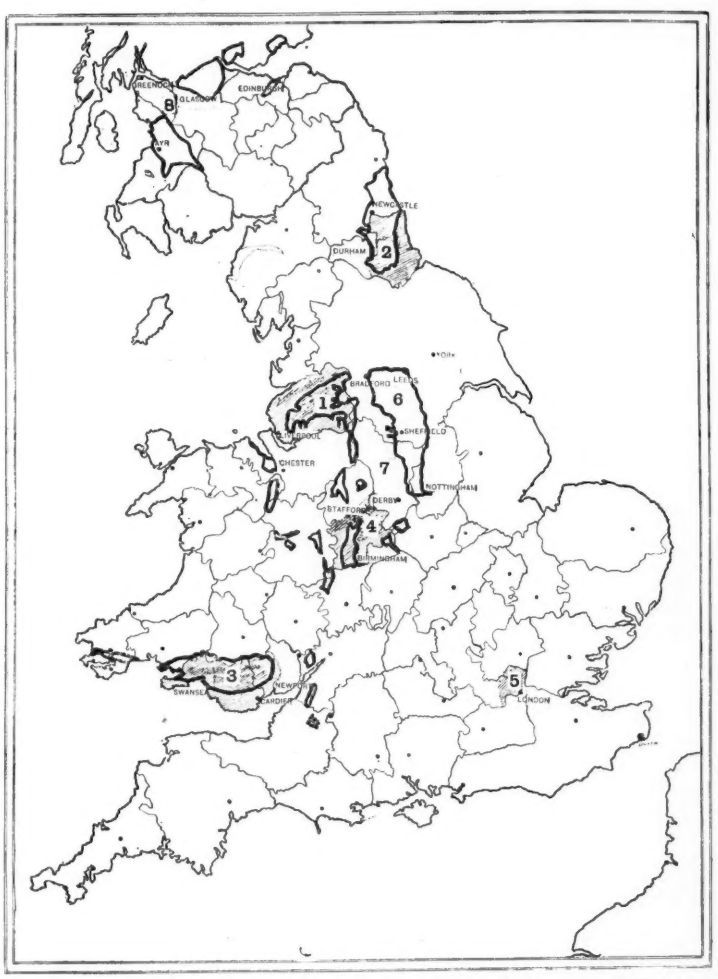
North Metropolitan Electric Supply Company.—This Bill comprises in its operation the right to supply electricity in bulk to that area of North London confined within the limits of Tottenham in the east, and Harrow in the west, and it includes also the growing manufacturing district along the River Lea; the total area comprised is 325 square miles.

County of Durham Electric Power Bill.—The area comprised in this Bill is 250 square miles, and includes the main portion of the Durham coalfields, as well as the principal manufacturing and shipbuilding districts on the North-Eastern coast. The Bills generally include the power to supply energy in bulk to authorised electrical providers. This includes:—

(*a*) Any electric lighting company.

(*b*) Any local authority, company, syndicate or firm, or person authorised to supply electrical energy, referred to in the Act as authorised distributors.

(*c*) Any local authority, company, body, or firm authorised



1. Lancashire. 2. Durham. 3. South Wales. 4. Midland. 5. North Metropolitan. 6. Yorksh (two schemes). 7. Derby and Notts. 8. Clyde Valley (two schemes).

Fig. 10. Map showing Coal Areas (Thick Lines), Supply Areas Sanctioned (Hatched) and Applied for.

* The other applications, such as floriculture, &c., are referred to in the author's paper of 1892.

to use electrical energy for prescribed purposes, and referred to as authorised users.

The electric power would be supplied by the power supply companies at prices varying from 3d. down to 0·9d. per B.T.U. In addition to these authorised areas of supply there is the South Staffordshire Power Supply Company's area ; in this application for powers the promoters, with extraordinary confidence, have limited the rate per B.T.U. to 1d. for bulk customers.

In the project formulated by Mr. James Swinburne in collaboration with the author, the estimate of profitable supply in bulk to large customers per B.T.U. was 0·65d. This estimate was based upon the most economic method of electric supply production, involving the recovery of the nitrogen as ammonia and the tar, and the fractional distillation of the latter to produce suitable hydro-carbons—the gasification of the fuel and its use in internal combustion engines always working at full load—and the price of coal was taken at 4s. 6d. at the pit. Any serious increase in the value of the coal might mean the destruction of the profit margin ; this possible difficulty is dealt with by the author in another section.

Besides the Electric Power areas defined, Parliamentary powers are being asked for South Yorkshire, for Derbyshire and Nottinghamshire, and for the Clyde Valley.

Once we have a few precedents of commercial success, the impetus to the power supply enterprise will rival that given to railway undertakings in 1845, and few counties in Great Britain will then be left outside the influence of Power Bill promoters' activity.

(To be continued.)

CONTRACTS OPEN AND CLOSED

(*Continued from page* 500.)

Leeds.—April 15th. The City Council wants tenders for steam and other piping, pumps, economisers, &c., all for engines of 4,000 I.H.P. See "Official Notices" March 15th.

Leith.—The T.C. wants tenders for a 350-KW. steam dynamo for lighting or traction. See "Official Notices" March 15th.

London.—April 24th. The Metropolitan Asylums Board invites tenders for gas producing plant and gas engines, dynamos, accumulators, and switchboard ; Galloway boilers, economiser feed pumps, &c., for Tooting Bec Asylum. See "Official Notices" to-day.

London.—The Metropolitan Electric Supply Company announce in our advertisement pages that they are considering the expediency of adopting larger units, and are prepared to receive designs, accompanied by full specification and approximate price (erected at their works in London) for complete two-phase steam units having an output of from 3,000 to 4,000 KW. at a pressure of 500 volts per phase, and at a periodicity of 60 complete cycles per second, such units to work in parallel with the existing 1,500-KW. units of the company. As an alternative, similar units generating at 10,000 volts may be considered. See "Official Notices" to-day.

Madrid.—April 21st. The Secretary of State for Foreign Affairs has received a despatch from his Majesty's Ambassador in Madrid, stating that tenders are invited by the Spanish Government, not later than April 21st, for the establishment and working of a telephone system in Palencia. Particulars may be examined at the Commercial Department of the Foreign Office, between 11 a.m and 5 p.m.

Manchester.—March 25th. The Electricity Committee is inviting tenders for the following for Bloom Street station :—(*a*) switchboard for connecting four 1,800-KW. generators to the lighting and traction systems ; (*b*) four continuous-current motors for driving mechanical stokers and economisers. Specifications, &c., on application to Mr. F. E. Hughes, secretary Electricity Department, Town Hall. £1 1s. for each specification.

Newport.—March 25th. The Corporation wants tenders for steelwork, bunkers, flue, coal conveyer, crane, water-tube boilers, stokers, economiser, tanks, compound condensing vertical engines, electric generators, condensing plant, feed pumps, &c., for electric tramway and power works. See "Official Notices" March 8th.

Partick.—April 9th. The Council wants tenders for steam and other pipes, pump, tank, feed water heater, and ironwork, &c. See "Official Notices" to-day.

Roumania.—April 3rd. Tenders are again being invited until April 3rd by the municipal authorities of Ploesti, for the construction of an electric tramway in the town and the working of the same during a period of 30 years.

Roumania.—April 10th. Tenders are being invited until April 10th by the municipal authorities of Piatra Neamtz for the concession for the electric lighting of the town during a period of 30 years.

Salford.—April 9th. The Corporation wants tenders for wiring for motors, dynamo leads, engine room and switchboard connections, &c., at the Strawberry Road generating station. See "Official Notices" to-day.

Stockton-on-Tees.—March 26th. The E.L. Committee wants tenders for an additional 300-KW. steam dynamo. See "Official Notices" March 15th.

Sunderland.—March 29th. The Corporation wants tenders for india-rubber-covered cables, stoneware casing, wrought-iron piping, and cast-iron piping, box frames and covers. See "Official Notices" March 1st.

Sunderland.—April 3rd. The T.C. wants tenders for 104 arc lamps, pillars, and accessories. See "Official Notices" to-day.

The Hague (Holland).—March 25th. The Communal Council administration wants tenders for the supply and erection of engines and electric plant for the electric lighting of the town.

Warrington.—March 27th. The Corporation invites tenders for steel rails and permanent way work; poles, brackets, trolley wire, insulators, &c. ; electric tramcars. See "Official Notices" March 1st.

West Ham.—March 22nd. The Council wants tenders for cables, cut-out boxes, wattmeters, transformers, wire and wiring accessories, and engine-room stores. See "Official Notices" March 8th.

Wigan.—March 27th. The Corporation wants tenders for paper cables, trolley line, steel poles, and castings. See "Official Notices" March 15th.

Wolverhampton.—March 23rd. The Tramways Committee wants tenders for the overhead equipment of 5 miles of route, also feeders, conduits and switch pillars. See "Official Notices" March 8th.

CLOSED.

Athens.—We learn that Messrs. Escher, Wyss & Co., of Zurich, have received the order for two triple-expansion Corliss engines of 1,200-B.H.P. each for driving the dynamos of the central station being erected for the electric tramways in Athens, by the Mediterranean Thomson-Houston Electrical Company.

Batley.—The tender of Messrs. J. Fowler & Co., Limited, for generating plant, to which we referred last week as being accepted, amounts to £5,617. The plant will consist of three steam dynamos, having a capacity of 150-KW. each. The dynamos will run at 550 revolutions per minute and the pressure is to be 525 volts. There will also be a balancer and a motor-generator, capable of giving 40 KW.

Belgium.—La Compagnie Internationale d'Electricité, of Liège, has just secured an order for a 100-H.P. steam dynamo for the extension of the Brussels central electric lighting station.

Bournemouth.—At Wednesday's Council meeting it was decided to accept the British Westinghouse Company's tender, of £28,020, for 38 electric cars (18 bogie and 20 ordinary truck cars). Tenders were received from the following firms :—The Hungarian Railway Carriage and Machine Works, Limited ; Hurst Nelson and Company, Limited ; British Westinghouse Electric, &c., Company, Limited ; Robert W. Blackwell & Co., Limited ; Siemens and Company ; British (? Brush) Electrical Engineering Company ; Bramigk & Co. ; British Thomson-Houston Company.

It was also decided to accept the British Thomson-Houston Company's tender of £14,733 for steam dynamos, &c. The following firms sent in tenders :—C. A. Parsons & Co., British Thomson-Houston Company, British Westinghouse Company, Johnson-Lundell, Lancashire Dynamo and Motor Company, Limited, Siemens and Co., Anchor Electric Company, Brush Electrical Engineering Company, Bow, McLachlan & Co., British Schuckert Electric Company.

Bradford.—The Corporation has accepted the tender of the Leeds Steel Works, Limited, for the supply of steel girder rails for the relaying of the Manchester Road line at £7 5s. per ton, and for fish-plates at £8 15s. per ton.

Croydon.—The County Council have accepted the tender of Messrs. Danks, for the supply and erection at the electricity works of two dryback boilers for £1,630. There were nine tenders for the boilers, ranging from £1,630 (the lowest) to £2,600.

France.—Tenders were opened on the 12th inst. at the French Ministry of Posts and Telegraphs in Paris, for the supply of a large quantity of gutta-percha insulated electric cables. As all the bids were higher than the price fixed by the Postal authorities, the orders were not given out.

Middleton.—The contract for the supply of a traction switchboard for the Corporation has been secured by the Brush Electrical Engineering Company.

Partick.—Messrs. D. Bruce Peebles & Co. are to supply the dynamos, &c., for the Partick Commissioners.

Potteries.—The British Electric Traction Company, Limited, have placed an order with Frank Suter & Co., Limited, of London, for two "Helios" tramway generators of 440-kw. each. These generators are for the Maybank Power Station of the Potteries Electric Traction Company.

FORTHCOMING EVENTS.

Friday, March 22nd.—At 8 p.m. Institution of Junior Engineers. At the Westminster Palace Hotel, Engineering Question Night.

Monday, March 25th.—At 8 p.m. Society of Arts. Cantor Lectures. "Electric Railways," by Major Philip Cardew, R.E., M.I.E.E. Lecture III.—Consideration of equipment and working of a full scale railway for suburban and main traffic on the polyphase system.

Wednesday, March 27th.—At 7.30 p.m. Institution of Electrical Engineers (Birmingham Local Section). General meeting will be held in the Physical Theatre of the University. A paper will be read on "Polyphase Equipment in Factories," by W. Wyld.

Thursday, March 28th.—At 8 p.m. Institution of Electrical Engineers. Ordinary general meeting at Institution of Civil Engineers. Papers on "The Electrical Transmission of Power in Factories," by H. W. Ravenshaw, and "Portable Electric Lamps," by S. F. Walker.

Friday, March 29th.—Electro-Harmonic Smoking Concert.

Saturday, March 30th.—Royal Institution of Great Britain. Lord Rayleigh on "Sound and Vibrations." (Lecture VI.)

Thursday, April 4th.—At 8 p.m. Civil and Mechanical Engineers' Society. Meeting at Hotel Victoria, Northumberland Avenue, S.W. Paper "On the Proportions of Cylinders for Multiple-Expansion Engines," by A. Hanssen, A.M.I.C.E.

NOTES.

Glasgow Exhibition.—The *Glasgow Evening Times* gives the following list of combined engines and dynamos which are to be erected at the Exhibition, and will form the generating plant :—

Builders of engines.	Builders of dynamos.	H.P.
Willans & Robinson ...	Crompton	1,200
Willans & Robinson ...	Schuckert	1,200
Robey	Scott & Mountain ...	150
Robey	Scott & Mountain ...	70
Robey	Mavor & Coulson ...	500
Ruston-Proctor	Ruston-Proctor	100
Scott & Mountain ...	Scott & Mountain ...	130
Alley & Maclellan ...	Mavor & Coulson ...	200
Browett-Lindley ...	Ediswan	500
Belliss & Morcom ...	Bruce Peebles	270
Sissons	Clark-Chapman ...	125
Davey-Paxman	Electrical Con. Co. ...	375
	Total	4,820

We understand that the National Telephone Company is preparing for the forthcoming Exhibition at Glasgow a complete reproduction of a telephone exchange in full working order.

The I.E.E. and Wiring Rules.—The discussion on Mr. Frank Broadbent's paper on "Wiring Rules," before the Newcastle section, occupied two evenings. At the close Mr. Broadbent suggested that as the task was apparently too much for the parent Institution, the local sections should collect and standardise the rules in their respective areas and send the gist of them to headquarters. The Council would then have only half-a-dozen sets of rules to consider instead of hundreds. By request, the author moved a resolution to this effect, which was seconded by Mr. Jos. Jeckyll and carried with enthusiasm.

This appears to be one of the most promising results of the decentralising policy of the Institution; we trust that the idea will be taken up by the other sections, and the present chaotic condition of this matter reduced to order.

Lectures.—Mr. E. T. Williams, of King's Lynn, delivered a lecture at Union Chapel Lecture Hall (Dr. McLaren's), Manchester, on 5th inst., entitled "Electricity in the Service of Man." The lecture was illustrated by lantern views. Mr. E. W. Hoyle, M.A., of Owens College, presided.

On Monday night Major Cardew delivered his second Cantor lecture on "Electric Railways" before the Society of Arts.

On 12th inst. Prof. Fleming lectured on "Telegraphy with and without Wires" at the St. James's Hall, Kingston-on-Thames.

Mr. William Tatlow, M.A., has been lecturing at Sligo Town Hall on "Electricity and its Industrial Application."

Mr. H. T. Haws lectured before the Nottingham Engineering Guild on 18th inst. on "Electrical Engineering as Applied to Tramways and Power Schemes."

Under the auspices of the Eastern Branch of the Secondary Teachers' Association, Dr. W. Peddie, F.R.S.E., gave an address on "Recent Developments in Electricity," in the Natural Philosophy Class Room, Edinburgh University, on Saturday.

Personal.—Mr. Wm. Boyd asks us to announce that he has severed his connection with the Central London Railway Company. During the construction of the line he was one of the engineering staff of the Electric Traction Company, joining the railway company's staff when the line opened, to organise their electric lighting department, of which he has since had entire control.

Mr. J. A. Robertson, assistant engineer at Stirling electricity works, has received an appointment in the electrical department of Messrs. Denny's shipbuilding works at Dumbarton.

On Saturday evening, at the "Coach and Horses," Greenwich, Mr. J. Swaisland was presented with a cheque and address on his retirement after 35 years' service with Messrs. Siemens Bros. & Co., Limited, Woolwich. For 28 years he has held the position of principal foreman of the instrument department. Mr. Geo. Taylor presided over a crowded gathering composed of past employés who had worked under Mr. Swaisland. Mr. J. Hodgson asked Mr. Swaisland, on behalf of the 98 subscribers from all parts of the country and even abroad, to accept a cheque and an address on vellum. Mr. J. Swaisland replied in suitable terms. Various toasts followed.

Owing to ill-health, Mr. Rae, of the Kimberley municipal electric lighting department, was recently granted leave of absence.

The Berliner Telephone Patent.—Judgment has been given in the case of the American Bell Telephone Company against the National Telephone Manufacturing Company and the Century Telephone Company in the United States Circuit Court of Massachusetts. In this case suit was brought to prevent the defendants using microphonic transmitters, infringement of the Berliner patent (dated November 17th, 1891, but applied for June 4th, 1877) being alleged. The decision now given by Judge Brown is in favour of the defendants. The judge finds the patent invalid because at the date of application Berliner had not made the invention covered by the patent, the invention described in the patent being radically different from the invention described in the application. A further ground of invalidity is found to be the 1880 patent of Berliner, in which the same invention as covered by the 1891 patent is disclosed. The decision is regarded as one of great importance by the "independent" telephone companies in the United States. A previous judicial decision annulling the patent was reversed on appeal. In the reports so far received no indication is given as to whether an appeal will be made in the present case.

A Carnegie Gift.—New York *Science* says that Mr. Andrew Carnegie "has presented $32,500 to the Iron and Steel Institute, London, for the foundation of a research scholarship." Mr. Carnegie and Mr. Pierpont Morgan, as representing the United States Steel Corporation, will do their level worst for the steel manufacturing business of this country, but Mr. Carnegie as Mr. Carnegie helps us to better prepare ourselves to fight him by the foundation of a scholarship! Will Mr. Morgan please do the same?

Trade Announcements. — The Northern Electrical Company has purchased the installation department of the Keighley Electrical Engineering Company, Limited, and intends carrying on business at Keighley, Doncaster, York, Grimsby, and elsewhere, under the joint management of Mr. Percy Watson and Mr. Stephen and Frederick Emerson, who have had a long and wide experience.

Messrs. H. Schomburg & Söhne, of Berlin, have appointed Mr. F. W. Ostermann, of 27, Leadenhall Street, London, E.C., their sole representative for England and the Colonies.

We understand that Mr. A. H. Hunt is leaving the Edison & Swan Electric Co., and starting business on his own account, having taken premises at 59, Gresham Street, for showrooms, stores, and offices. He intends supplying the trade only with plant, fittings, and accessories of all kinds. Mr. Hunt's long experience in the electrical industry, extending over 16 years, including eight in the service of the Ediswan Co. in a responsible capacity, connected with buying, estimating, pricing, and other technical and administrative work, will stand him in good stead in his new sphere.

Niagara Falls—Buffalo Transmission Line.—The Niagara Falls Power Company is building a new power transmission line between its central station at Niagara Falls and its terminal station in Niagara Street, Buffalo. A very important feature in the construction of this new line is that aluminium cables are being strung upon it. The new cables are three in number, or one three-phase system. The cable used is of 300,000 circular mils, and is composed of 37 strands of wire, size about No. 10. This is the first application of aluminium cable to transmission purposes by this great power company. As copper is nearly 3½ times as heavy as aluminium, the aluminium cable is much lighter than a copper cable of a size to do the same work would be. This fact makes it possible to set the poles of the new line farther apart than are the poles of the old line. For instance, the poles of the old transmission line are placed about 75 feet apart, while the poles of the new line are 112½ feet apart on the average. This is a material factor in reducing the cost of construction. Another economy is effected by the new right of way, followed by the new line. By this route, the distance saved is over three miles. As soon as the new line is ready for transmission, the voltage on both lines is to be changed. At present the voltage of the power sent to Buffalo is 11,000, but it will be raised to 22,000. This will allow of increasing the amount of power sent to Buffalo to 30,000 H.P. At present the amount being sent over the copper line is 10,000. While the work of constructing the new line is in progress, careful attention is also being given to straightening out the crooked places on the old line. In selecting the new right of way, care was taken to have it as straight as possible. The fact of its being straight lessens the strain on the cables, and there is less liability of the cables pulling away from the pins and insulators. However, the Niagara Falls Power Company has enjoyed great freedom from accidents of this kind, and for over a year there has been but a single very brief interruption of the power service between Buffalo and Niagara Falls. The aluminium cable for the new line was furnished by the Pittsburg Reduction Company. The aluminium was made in this company's Niagara Falls works, and the wire for the cables was drawn in the Kensington, Pa., plant. Thus the power of Niagara and the furnaces and mills of Pennsylvania have joined in furnishing to the world another great work.

Appointments Vacant.—The St. George's Union wants a chief engineer to take charge of its heating and electric light plant. An inspector of motormen is wanted at Southend-on-Sea.

Motor Cars in Warfare.—Major H. C. L. Holden lectured at the Royal Artillery Institution the other day on "The Automobile and Its Possible Uses in Warfare." He placed electrical vehicles outside the range of practical use.

The Electro-Harmonic Society.—On Friday evening next the last smoking concert of the present season will take place. The programme is an exceptionally good and varied one, and what with orchestral selections (amongst them the charming "Nell Gwyn" dances by Edward German), recitations, short stories by Mr. Frederic Upton, humorous sketches by Mr. Harrison Hill, violin soli and songs, there should be something to please all tastes.

CITY NOTES.

Oxford Electric Company, Limited.

The annual meeting was held on 8th inst., Sir Henry C. Mance presiding.

The Chairman said that the revenue account showed a profit of £5,125 3s. 8d. After providing £1,965 10s. 11d. for debenture and other interest, and writing off £254 0s. 11d. on account of hire-purchase installations, the available balance of net profit was £2,905 11s. 10d., which the directors proposed to appropriate as follows: In payment of a dividend at the rate of 5 per cent. per annum on the share capital, £2,500, and in adding £250 to the reserve and renewal of plant account, which would then amount to £2,000, leaving £155 11s. 10d. to be carried forward to next year's accounts. The capital expenditure in 1900 amounted to £6,020. A new Paxman "Economic" boiler had been installed. The new unit of generating plant (225 KW.) had just arrived at the station. It had been manufactured for them by the Electric Construction Company, of Wolverhampton, and was coupled with a Willans high-speed engine. This type was different from the machines they had been hitherto using, but it had been adopted in order to effect a saving of space at the generating station, and to avoid the loss of power absorbed by the belts. Their present plant, including this new generator, would, with the addition of one or two transformers, enable the generating station to supply about 45,000 or 50,000 8-C.P. lamps installed. At present, as near as they could estimate, they had the equivalent of 34,000 8-C.P. lamps connected. The expenditure under the heading of mains, £3,027, had been in connection with the extension of the supply. The item hire-purchase installations, £1,001, represented the cost of 45 hire-purchase installations arranged for during the year. They have added more than 2,000 lamps to the system. The amount written off this item was taken on the basis of the cost of the installation divided by the period of time for which the payment of the rental was guaranteed. To defray the cost of the capital expenditure during 1900, £5,700 debenture stock had been issued. Passing to the revenue account, they would naturally expect that their coal bill had been greater than during the previous year. In the first place, they had generated more current, and, secondly, the price per ton of all classes of coal had been considerably higher in consequence of the war and other causes. The cost of coal per unit delivered had been ·76d. The wages at the distributing stations were slightly lower, but their high-tension mains had given trouble, necessitating a good deal of labour being expended upon them. Fortunately these mains were the less costly portion of their system of distribution. The expenditure under this head had been entirely confined to the maintenance of the high tension system, no trouble whatever having been experienced with the low-tension distribution mains. Passing to the credit side of the revenue account, the increase in revenue, notwithstanding the reduction of price, had been £336, the number of units sold having been 13 per cent. more than in 1899. The net revenue from street lighting was somewhat less by reason of the increased cost of materials, especially that of carbon. In explanation of the reduced amount of gross profit, it must be borne in mind that this had been occasioned by the reduction in the maximum price from 7d. to 6d. Time must necessarily elapse before even a substantial reduction in the price of current would have its full effect. The number of consumers added had been about 80, and the total number of lamps added had been 3,722, as against 3,638 in the previous year. The report was adopted.

Potteries Electric Traction Company.

Mr. Emile Garcke presided at the meeting held on Tuesday at Cannon Street Hotel, and in moving the adoption of the report, he said that the carrying into effect of the agreement between the Potteries Company and the North Staffordshire Company had resulted in the accounts being prepared in a much simpler form. The amount paid to the North Staffordshire Company was £11,425. On the other side in the accounts appeared £9,799, which was the proportion received on the debentures and shares which this company holds in the North Staffordshire Tramways Company. The progress of the company during the year had been really very much greater than was perhaps apparent from the results shown in the profit and loss account. The alteration in the form of the accounts rendered a correct and complete comparison impossible. It might, however, be of interest to give a few figures by way of showing what a great work the company was doing. Five years ago the total passengers carried by the N.S.T. Company were about 3,000,000. During the past year this company carried nearly 10,000,000. The total receipts five years ago were £18,600, and last year over £54,000. Various circumstances had combined to have an adverse effect upon the year's net results. All undertakings of

the kind had been seriously prejudiced by the high price of fuel, the difference in their accounts in this respect being about £1,000. The rate of wages was rather high, and would continue so. The cost of insurance against accidents would be reduced in future. The strike of potters and bricklayers, which lasted about two months, had affected them, not only by reducing the traffic for that period, but by delaying the completion of the power house, and, in turn, preventing the opening of some of the outlying lines. The loss of traffic would be about £1,000, and the delay in opening the Chesterton and Silverdale route would be about another £1,000. But for these exceptional items, the net result would have been larger. The net profit was £13,839, out of which they paid 5 per cent. on preference shares and 2 per cent. on the ordinary, and placed £500 to depreciation. The last item they thought was ample on this occasion, having regard to the fact that the line, rolling stock, and power houses were kept in a high state of efficiency, and the cost of that maintenance was entirely charged to revenue account. If one made a minute analysis of expenditure on maintenance, they would have no difficulty in justifying a fairly large proportion of that account being charged to capital, but the board thought that it was better that the lines should be maintained in the fullest state of efficiency out of revenue, and the surplus, after paying reasonable dividends, should be applied to building up a strong reserve or sinking fund to protect them against the risk of expiring tenure and possibly, in years to come, the replacement of permanent way or some of the plant. He had, therefore, no doubt that on future occasions they would advise them to put even larger sums to the reserve and sinking fund. The traffic receipts would show a very considerable increase during the current year. The £54,000 which they had received in traffic this year had been in respect of only a small portion of the total system which the company was now operating. Only a small terminal piece of line now remained to complete, and when that was ready they would be running 30 miles of line. They had issued £125,000 4½ per cent. debenture stock. The issue was made at a time which was not very favourable for an issue of that kind, and the subscriptions did not come up to expectations. It was necessary to withdraw the first issue and make a second under improved conditions. The British Electric Traction Company assisted them in the matter, and agreed to guarantee the principal, interest, and premium, and with that very improved guarantee they were able to establish a really gilt-edged security, and there was no difficulty in raising the debentures. The B.E.T. Company assisted the company further in the matter and paid the expenses of the issues, and by way of consideration for those services the Potteries Company gave them the option of taking up the remaining £75,000 debentures at par at any time before April 27th this year. There was an amount in abeyance as claimed by the contractors. The amount was referred to arbitration, and was not yet completely settled. It was a matter of about £5,000 to £6,000. They were applying for a light railway order for certain extensions. The chairman referred to the opposition which they met with in earlier times at the hands of local authorities, but experience had shown that when they got their electrical lines to work these authorities appreciated the value of services that the company was rendering in their districts. They were being pressed by local authorities to extend the lines to outlying villages, but the capital outlay involved was very considerable, and unless they could thoroughly satisfy themselves that the capital was likely to be remunerative they would not feel justified in extending to sparsely populated districts around the Potteries. For such places, however, they were trying the experiment of a service of steam omnibuses. If successful, they would extend it. They were negotiating with local authorities for transfer of electric lighting powers. They could supply, from their power stations, small places which could not afford to do the work for themselves. The company was establishing a service for carrying parcels and goods throughout the Potteries district. After referring to several minor matters, the speaker formally moved the adoption of the report.

Major Pilkington seconded, and it was carried unanimously after a few questions had been asked and satisfactorily answered.

The retiring directors and auditors having been re-appointed, a resolution was passed increasing the capital from £400,000 to £600,000 by the creation of 20,000 £10 shares. The meeting then became special to approve certain alterations in the articles.

Imperial Tramways Company.

The report of the directors to be submitted to the meeting to be held to-morrow at Bristol reads:—

"The directors beg to submit the balance-sheet and general revenue account made up to December 31st last, together with details of the revenue accounts of the subsidiary companies.

"*Middlesbrough, Stockton and Thornaby Electric Tramways.*—The gross receipts of these electric tramways amounted to £47,218 17s. 9d., and the number of passengers carried to 8,782,970, compared with totals of £45,372 13s. 8d. and 8,307,322 in the preceding year. These figures indicate a steady development and increasing popular favour, results which the directors are fostering in every possibly way in their conduct of this important business. The net profit for the year amounts to £14,637 10s. 9d., which is slightly in excess of that of the previous year, and represents a return of about 6⅝ per cent. upon the capital employed. The extension of the Middlesbrough line to Clarence Ferry is in course of construction and the additional rolling stock under order, so that this branch will be opened in good time for the summer traffic.

"*Darlington Tramways.*—The net profit resulting from the year's operation of this horse tramway amounts to £738 13s. 6d., and this sum is carried to the credit of the general revenue account. The Corporation have recently made overtures to the company with a view to the immediate acquisition by the authority of the company's undertaking and orders, and friendly negotiations are now proceeding which will probably result in terms being agreed.

"*London United Tramways.*—As usual, the directors' report and accounts of this company are reprinted in their entirety for the information of the Imperial shareholders. In the course of the year the Imperial Company have increased their interest in this important undertaking to the extent of 10,000 preference shares and 2,000 ordinary shares. Of the former, 2,000 shares are fully paid up and carried dividend for the whole year, and 8,000 shares have £1 5s. per share only paid up, and receive dividend for the second half-year. The 2,000 new ordinary shares have as yet only £1 per share paid up and will rank for dividend as soon as the London United lines are put into electrical operation. The dividend on the fully-paid ordinary shares was at the rate of 10 per cent. for the whole year, and the income from the Imperial Company's investment amounted to a total of £16,900 for the period.

"*Reading Tramways Company.*—The year's working of this company's horse tramway system continues to show a satisfactory result, the net revenue being again sufficient for a dividend at the rate of 8 per cent. on the share capital, the whole of which is owned by the Imperial Company. The Board of Trade have appointed Sir Frederick Bramwell, Bart., F.R.S., as the arbitrator to determine the price to be paid by the Corporation for the Reading tramways, but the Corporation have recently inquired if the directors were willing to suggest a reasonable price for agreement in order to obviate the necessity for any arbitration, and the directors are giving the subject their careful consideration.

"*Corris Railway Company.*—The result of the past year's working is again satisfactory, and a dividend on the ordinary stock at the rate of 6 per cent. for the year has been received.

"*General.*—It will be seen that the company's net revenue account for the year shows an available balance of £35,286 3s. 2d., and after payment of interest on the debenture stock for the whole year, and interim dividends on the preference and ordinary shares in respect of the half-year to June 30th last, amounting together to £23,386 9s. 2d., it is proposed to appropriate the balance as follows:—In payment of dividend at 6 per cent. per annum on the preference capital, £3,000; final dividend at 8½ per cent. per annum on the ordinary capital, £8,500; and to carry forward to the next account the remaining sum, £399 14s. In addition, the reserve funds have been increased during the year from £69,203 to £72,789. During the year the balance of the debenture stock has been issued, and the proceeds applied to the further investment above referred to in the London United Company. The directors consider that the company's position is such, that the preference dividend ought to be paid on fixed half-yearly dates, and accordingly in future the dividend will be paid on the preference shares at the same time as the debenture interest, *i.e.*, on January 1st and July 1st in each year. Mr. George White (director) and Messrs. James Fraser & Sons (auditors) retire at the ensuing meeting, and will be proposed for re-election. The dividends will be posted on the 25th inst."

Baker Street and Waterloo Railway Company.

The report to December 31st, 1900, states that the position brought about by the failure of the contractors, the London and Globe Finance Corporation, is receiving careful attention. The company has ample assets in cash, shares, and debenture stock to provide for the completion of the line, and negotiations are in progress for the transfer of the contracts to other parties. The directors are not, however, at present able to make any definite statement on the subject. In the meantime the works are in progress. The Marquis of Dufferin and Ava has resigned his seat on the board.

Mr. Hare presided at the half-yearly meeting, held at Westminster Palace Hotel on Monday. He stated that the total assets available to meet further expenditure on capital account amounted to £2,660,617. He proceeded to explain the position under the agreements between the company and the London and Globe Finance Corporation. The position with regard to the contract entered into for the construction of the railway authorised by the Acts of 1899 and 1900 was that the contractors had so far not been called on to commence, but by going into liquidation they had rendered themselves unable to perform it, and the company was at liberty to regard the contract as abandoned, and prove in the winding-up for any damages it could show it would suffer by that contract not being carried out. The company had ample assets to provide for the completion of the line, and negotiations were in progress for the transfer of the contracts to a strong financial syndicate, and the directors had reason to hope that those negotiations would terminate satisfactorily. Referring to the progress of the works, he stated that at the south end the railway began at the Elephant and Castle. Following in the direction of Waterloo Station, the site of the Indigent Blind School, on which the generating station was to be built, was recently purchased by the company for nearly £150,000. At Waterloo Station the South-Western Railway Company had been arranged with as regarded the means of communication. The station shafts had now been sunk, and from within about 130 yards of this point the western running tunnel had been driven under the river up Regent Street a little to the north of Vigo Street. The eastern tunnel had not yet been driven under the river; they were waiting for the shields that had been driving the western tunnel to be available, and these were now released. Commencing at the staging in the river this tunnel had been driven to the north of

Vigo Street, with the exception of a very small gap in Cockspur Street and at the bottom of the Haymarket. One of the station tunnels at the interchange station on the Embankment and both at Trafalgar Square and the two at Piccadilly Circus had been constructed, as well as the station shafts and the subways at Piccadilly. The next point at which the work was in progress was at the Oxford Street Station, where the site had been cleared and the sinking of one of the shafts was about to be commenced. Going north to Baker Street, the station shafts had both been sunk, and the western running tunnel had been driven to the top of Portland Place, while the up-tunnel had reached a point in Regent's Park about 600 yards from Baker Street. The works on the section between Baker Street and Paddington had not yet been commenced. The railway, running as it would through the very heart of central London and forming connections with about 12 other railways (including the other lines authorised) and numerous tramway lines, followed a route second to none in London. The high rate of working expenses on the Central London during the first five months was not to be taken as any criterion of what the rate of working electric railways would be in the future, and their company would have the advantage of profiting by the experience of the Central London Railway. A committee was now inquiring into the cause of the vibration of which so much had been heard of on that railway, but there was little doubt that the engineers would be able to obviate vibration on the Baker Street and Waterloo line. On the Waterloo and City and the City and South London Railways he was not aware that there had been any complaint of vibration. There were several schemes before Parliament for the construction of electric railways in London, but it was doubtful if any of them would be allowed to proceed this session. If so, the directors would carefully watch the interests of the company.

Sir Algernon West seconded the motion.

At a special meeting resolutions were passed approving the Brompton and Piccadilly Circus and the Charing Cross, Euston and Hampstead Railway Companies' Bills.

Notting Hill Electric Lighting Company, Limited.

The eleventh annual meeting of the shareholders of this company was held on Tuesday last at the offices, 140, High Street, Notting Hill Gate, Sir W. Crookes, F.R.S., presiding.

The Chairman, in proposing the adoption of the report, said he regretted that the accounts did not show a corresponding increase in the profits as compared with those of the previous year. The capital expenditure during the year had amounted to £27,639, raising the total expenditure on capital account to £164,990. The principal items of expenditure last year were on account of new mains and on machinery to meet the increased demands for current. The cost of the new mains amounted to £12,198 and the additional expenditure on fixed machinery to £8,282, representing the cost of the motor generators and accessories in the distributing stations. Those were required by the company to enable them to utilise the current generated in the Wood Lane works. The sum of £6,514 spent on land and buildings was represented by the site and buildings at Lancaster Road and the new buildings at the rear of the company's premises in Notting Hill Gate. Turning to the revenue account, the profit amounted to £9,856, and, comparing that with the profit of the previous year, there was a reduction of £504. That was more than accounted for by the two items of the extra cost of coal, and the cost of renewing the accumulators. But for those payments the profit would really have shown an increase of 10 per cent. The price of coal still remained high, but they might look forward to some reduction, and, of course, they did not anticipate a repetition of the expenditure of £1,200 on accumulators for a long time. The net revenue account showed a balance of £7,444, after deducting depreciation and interest on debentures and the new ordinary shares. The depreciation and renewal account had been raised from £6,000 to £11,000 by the addition of the premiums received on the issue of the new shares and debentures, and by putting aside out of the profits £742. That might not appear a very large sum, but the directors considered it sufficient, as they were adding the whole £4,257 received as premiums, and were not charging against that account the £1,200 spent on renewals and accumulators. It was rather a matter of conjecture as to what amount of capital they would have to spend this year, as it depended to a large extent on when they were able to obtain a site for the generating station in the South-Western portion of their area of supply. Regarding the progress of the company, at the end of the first year, 1891, they had 77 customers. They now had 1,191, and the number of lamps connected had increased from 6,056 to 68,505. He would like to refer to the serious difficulty the company had had to contend with in the overloading of the present mains and the inability of the plant and machinery adequately to meet the demand for current during the winter months. To that was due the fact that during some of the dark days of winter they had had complaints as to the inadequacy of the pressure. That was due to their being compelled, almost against their will, to take new customers, while in reality they were only able properly to supply those to whom they had already bound themselves. The result was that their machinery was overworked and some of it was put temporarily out of gear, but so far as their customers were concerned, all they suffered was an occasional dimness of light. That was a novel and unpleasant experience for them, as well as for the company, but they had already obtained sufficient power to cope with their present requirements, and they sincerely trusted that such an annoyance would not recur. Their thanks were due to their customers for their forbearance and consideration. The directors, in the Bill they were promoting in Parliament, were taking powers to acquire compulsorily a site in the Addison Road district in order to erect thereon a distributing station. Two sites had been scheduled. Objections had been raised by the freeholders, but as it was not intended to generate the electricity or to have engines or boilers on the site, and as the buildings to be erected would merely contain some practically noiseless transforming and distributing machinery, he hoped Parliament would pass the Bill. They were now able to send out a considerable quantity of current from Wood Lane, but unfortunately it would not be available in the Addison Road district until they could erect machinery to distribute it in the area. They were therefore in the unsatisfactory position of having to refuse customers in that district until they could fix a date for the erection of the distributing station. It must, however, not be overlooked that they had certain obligations to perform in accordance with their provisional order, and consequently some way out of the difficulty must be found, and any delay in obtaining the compulsory powers they sought would be a serious matter. Once out of that difficulty he hoped they might look forward to a long period of prosperity. To supply the northern part of their district in Notting Hill a distributing station had been erected and would soon be in operation in Lancaster Road. It was now being equipped with the necessary machinery to utilise the current received from the Wood Lane Works. The other distributing station at the rear of the company's offices had been working satisfactorily for some time. The engineer advised that these arrangements as soon as they were complete would enable them to resume connecting new customers in all parts of their area of supply and very largely to increase their business, and from the number of applications already received it was evident that much business awaited them.

Mr. J. W. Swan seconded the motion, which was carried unanimously.

The retiring directors and auditors having been re-elected, an extraordinary meeting was held, when the resolution approving of the company's Bill now before Parliament, which was passed at a meeting held on February 27th, was confirmed.

Direct Spanish Telegraph Company.

The directors' report for the year ended December 31st, 1900, to be presented at the meeting to be held on Tuesday, March 26th, reads as follows:—

The annexed accounts for the year ended December 31st, 1900, show, after providing for interest on, and redemption of, debentures, a balance to the credit of revenue of £10,817 18s. 9d. After adding the usual sum of £5,000 to the reserve fund, the balance will amount to £5,817 18s. 9d., and the directors recommend the declaration of dividends for the year 1900 of 10 per cent. on the preference shares and 4 per cent., free of income-tax, on the ordinary shares, amounting to £5,448 11s. 8d. Half of this amount was distributed on October 1st, 1900, as an interim dividend for the half-year ended June 30th, 1900. There will then remain a balance of £369 7s. 1d., which it is proposed to transfer to the contingencies account, and this account will then amount to £566 2s. 6d. The traffic receipts show an increase of £1,0s9 8s. 4d. as compared with the year 1899. The ordinary working expenses show a decrease of £210 4s. 9d. as compared with the year 1899. On November 17th, 1900, the Falmouth-Bilbao cable broke at a distance of about 70 miles from the Spanish landing. The Eastern Telegraph Company's cable ship *Amber* was engaged to effect the necessary repairs, and left as soon as possible, but owing to exceptionally bad weather experienced in the Bay of Biscay, the ship was only able to complete the work on December 18th, 1900. The cost of these repairs, viz., £6,975 13s 3d., has been taken from the reserve fund. The directors regret to state that the Bilbao cable again broke down quite close to the Spanish coast on December 27th, having been severed by a ship's anchor. The cable was restored on January 23rd last, and has worked well since. On January 6th, 1901, the Barcelona-Marseilles cable was found to be broken, and owing to a continuance of very bad weather in the Mediterranean, it has not been possible to repair it up to the present date. It is hoped, however, that it will be restored in a few days. The considerable expenditure which will be occasioned by these breaks amply justifies the policy of the board in not paying more than a 4 per cent. dividend on the ordinary shares, and in building up a reserve fund. It was found necessary to relay and deviate a considerable portion of the underground lines connecting the company's office at Bilbao with the landing-place of the cable. With the alterations previously made, there are now practically two new underground cables at Bilbao. The cost of the work was £1,539 14s., which the directors have taken from the reserve fund. The Quinquennial International Telegraph Conference was to have been held in London in May, 1901, but owing to the lamented death of the Queen, the British Government has postponed this Conference till 1902. Mr. F. Alexander Johnston is the director retiring by rotation, and offers himself for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., retire, and offer themselves for re-election.

Davis & Timmins, Limited.

Sir Henry Mance presided at the annual meeting of this company held at Winchester House on 14th inst. In moving the adoption of the report, the chairman congratulated the shareholders upon the state of the business, and expressed deep regret at the loss sustained by the death of the late managing director, Mr. Davis. Mr. Le Neve Foster had been appointed to his place, and would be assisted by Mr. George Davis. After going through the various items in the accounts, the chairman said that during the year £8,275 had been expended upon additional machinery, most of which is now in position, and includes a gas engine and gas generating plant. During the year they had carried out the work of equipping their factory with electric driving. The net profit of the year, including the amount brought forward, and allowing for depreciation, was £11,356. The directors proposed a dividend of 8 per cent. on the ordinary shares, leaving £1,990 to be carried forward. A portion of the machinery at York Road is being moved to Wood Green, so as to give the space which is so badly needed at the former place, and also for the purpose of placing machinery of the same class under the same management.

Mr. Le Neve Foster, in seconding the adoption of the report, paid a tribute to the memory of the late Mr. Davis.

The report was unanimously adopted, and the auditors were re-elected.

Newmarket Electric Light Company.

The annual meeting was held on Monday, Mr. G. H. Verrall, presiding. The directors in their report stated that they were satisfied with the steady progress that had been made during the past year. Equivalent to over 2,000 8-c.p. lamps had been connected to the mains. The profit on the year's working, added to £47 8s 9d. brought forward from the last account, amounted to £581 14s. 2d., which after providing for the debenture interest, £375 19s., left a balance of £205 15s. 2d., which it was proposed should be carried forward to next year.

The Chairman stated that at the present moment there were connected with the mains 7,431 8-c.p. lamps, for 101 consumers, and applications had been received for a further 1,415 lamps, from eight consumers. The company were putting down additional plant for the supply of 6,000 8-c.p. lamps. When the mains were extended to additional roads, he had every reason to believe that there would be many more applications. Electric lighting companies did not usually pay a dividend before the fourth or fifth year, but he expected that they would be able to declare a dividend in the third year. Mr. F. E. Gripper seconded the motion, and it was unanimously adopted.

City of London Electric Lighting Company.

The report of the directors which was submitted to the meeting held at Cannon Street Hotel yesterday (Thursday) afternoon reads as follows:—

1. Your directors beg to submit their report and a statement of accounts for the year ended December 31st, 1900, as certified by the auditors.

2. *Capital.*—The expenditure on capital account during the year ended December 31st, 1900, amounted to £242,974 11s. 3d. Details of this outlay are given in the capital account No. 3.

3. *Revenue.*—The total revenue for the year was £223,776 10 3

From which must be deducted the following items:—

Expenses of generation and distribution ..	£106,750 16 4		
Rent, rates, taxes, general and special charges	33,009 18 4		
Transfer to repairs and maintenance fund	25,000 0 0		
Expenses of issues of ordinary shares and second debenture stock	2,285 7 9		
Interest on loans, &c.	4,422 9 5		
		171,468 11 10	
Leaving		52,307 18 5	
To which must be added the balance brought forward from 1899		1,622 14 5	
Making a total available revenue of ..		53,930 12 10	
Of this sum the following amounts have been distributed or provided for:—			
(a) Interest on first and second debenture stock for year ended December 31st, 1900	£19,687 13 8		
(b) Interim dividend on £400,000 6 per cent. preference shares, paid in July last on account of the distribution for the year	11,500 0 0		
		31,187 13 8	
Leaving a balance of		£22,742 19 2	

Your directors recommend that a final dividend of 6s. per share for the six months ended December 31st, 1900, be declared, subject to the deduction of income-tax, on the company's preference shares, Nos. 1 to 40,000, making with the dividend of 6s. per share paid on account in July last, a distribution at the full rate of 6 per cent. per annum on such shares. This will absorb £11,400 and leave a balance of £11,342 19s. 2d. which your directors propose to carry forward.

It is proposed that the warrants for the dividend on the preference shares shall be posted on March 23rd, 1901. The generation and distribution expenses for the year, including repairs and renewals, were 61·13 per cent. of the gross earnings, as compared with 49·31 per cent. for 1899, 36·1 per cent. for 1898, 31·3 per cent. for 1897, 34 per cent. for 1896, 36·87 for 1895, 46 for 1894, and 54·2 for 1893. This unsatisfactory result is due to the high price of coal which obtained in 1900, and to the low average price per unit received from consumers.

Average Prices per Unit Obtained.

In 1895.	In 1896.	In 1897.	In 1898.	In 1899.	In 1900.
7·56	7·41	7·30	6·22	5·16	4·09

Your directors, in view of these circumstances, have made a modification in the tariff, which it is believed will result in a substantial increase in the revenue. As a result of the recent capital expenditure, it is anticipated that very considerable economies in the works costs will be possible during the current year. The following comparative statements show the position of the company as it was in 1893 and at subsequent periods:—

Number of Customers and Lamps Connected (City of London Company).

	Dec. 31st, 1893.	Dec. 31st, 1894.	Dec. 31st, 1895.	Dec. 31st, 1896.	Dec. 31st, 1897.	Dec. 31st, 1898.	Dec. 31st, 1899.	Dec. 31st, 1900.
Number of customers being supplied	1,080	2,740	4,230	5,303	6,322	7,414	8,738	9,855
Number (equivalent) of 8-c.p. lamps connected ..	65,341	135,460	196,317	247,785	296,012	355,825	429,628	511,113

On March 6th, 1901, there were 540,389 8-c.p. lamps (equivalent) applied for, out of which 521,651 were connected, and the customers numbered 10,074. The B.O.T. units sold during the year 1900, excluding public lighting, were 11,272,968, as compared with 7,446,703 for 1899.

Statement of Income as Shown in the Accounts Issued by the City of London Company.

For the year ended	Dec. 31, 1893.	Dec. 31, 1894.	Dec. 31, 1895.	Dec. 31, 1896.	Dec. 31, 1897.	Dec. 31, 1898.	Dec. 31, 1899.	Dec. 31, 1900.
Gross revenue (after deducting allowances to consumers) ..	£ s. d. 39,662 17 9	£ s. d. 68,863 19 8	£ s. d. 106,999 17 2	£ s. d. 146,946 14 7	£ s. d. 175,792 13 2	£ s. d. 175,607 15 8	£ s. d. 187,253 16 7	£ s. d. 223,776 10 3
Net revenue available for depreciation, reserve fund, interest on debenture stock, &c., dividends and special charges.	16,940 14 10	34,865 2 6	59,100 5 11	85,701 8 3	107,550 2 4	97,842 1 6	87,328 18 2	84,015 15 7

4. *The City of London Electric Lighting Act*, 1900.—This Act has relieved the company of the statutory obligation of setting aside a fixed percentage for depreciation every year, and the matter is now left to the discretion of your directors. In view of the fact that the sum of £16,349 6s. 6d., which had been accumulated mainly out of revenue in former years, and which until the passing of the company's 1900 Act could be used for any purposes of the undertaking other than for equalising dividends, has now been added to the depreciation fund, which stands at £96,045 15s. 7d., and that the large sum of £23,486 4s. 11d., out of £25,000 set aside from revenue for the purpose, has been expended during the past year in maintaining the company's plant, buildings, &c., in an efficient state of repair, your directors have not thought it necessary to provide any further amount for depreciation out of the revenue for the past year. This Act also authorised the company to acquire compulsorily certain properties which are essential to the development of the Bankside works. Some of the properties have been purchased since December 31st, 1900, and negotiations are proceeding as regards the others, and there is a further capital liability in respect of the cost of the same, which will have to be provided for.

5. *Additional Capital.*—As only 10,595 ordinary shares out of the 20,000 offered to the shareholders were subscribed for, your board, to meet the commitments for capital expenditure, were compelled to obtain the sanction of the shareholders to further borrowing powers to the extent of £400,000, and these powers have been exercised by the creation of second debenture stock for this amount, of which £200,000 has been issued and subscribed.

6. *Contracts with the Corporation.*—The declaration of Mr. Justice Farwell in favour of the company that the three contracts with the late Commissioners of Sewers were valid, has been varied by the Court of Appeal to the extent that two are invalid and that one is valid. This decision does not affect the company's statutory right to supply electricity for private purposes throughout the City, but concerns principally the arrangements made with the Corporation, by the company's predecessors, for the public lighting of the streets in the central and western districts of the City. Your board are giving their careful consideration to the matter.

7. *Directors.*—In accordance with the articles of association, three of their number, Mr. Joseph Bevan Braithwaite, jun., Mr. Herbert Samuel Leon, and Mr. Edward Lucas, now retire, and being eligible, offer themselves for re-election.

8. *Auditors.*—Messrs. W. H. Pannell & Co. retire, and being eligible, offer themselves for re-election.

Bournemouth and Poole Electricity Supply Company.

The directors' report to be presented to the meeting to be held at Moorgate Court, E.C., on Tuesday, March 26th, reads as follows:—

The directors beg to submit their report and statement of accounts for the year ended December 31st, 1900. The capital expenditure incurred during the year in respect of the Bournemouth provisional order, 1890, amounted to £26,312 2s., particulars of which are given in capital account, No. 4. The issue in March, 1900, of £70,000 4½ per cent. debenture stock was over subscribed, and the premium received therefrom, after deducting the expenses of issue, has been carried to reserve. The balance from revenue account, together with the balance brought forward from last year, amounted to £12,579 13s. 2d., from which must be deducted interest charges, depreciation, &c., leaving the sum of £8,052 10s. 5d. to the credit of net revenue account, as against £6,799 1?s. 5d. for 1899. Out of this sum the full year's dividend on the preference shares has been paid, and the directors now recommend the payment of a dividend on the ordinary shares of the company at the rate of 6 per cent., less income-tax, for the year ended December 31st, 1900. These payments absorb £7,391 5s. 9d., leaving a balance of £661 4s. 8d. to be carried forward. The equivalent of 53,379 8-c.p. lamps were connected to the company's mains in Bournemouth at December 31st last, showing an increase of 9,283 8-c.p. lamps for the year, and applications representing a further 1,896 8-c.p. lamps were then awaiting connection. The application of the Bournemouth Corporation in the last session of Parliament for a provisional order in competition with the company was refused by the Board of Trade in respect of private lighting. The construction of the tramways between Bournemouth and Poole is practically completed, and the company will shortly be supplying the necessary power for the working of the line. The Richmond (Surrey) Electric Light and Power Company, Limited, continues to make satisfactory progress. The directors have declared a dividend upon the ordinary shares of that company at the rate of 5 per cent. per annum in respect of the year ended December 31st last, as against 4 per cent. for 1899. The retiring directors are Mr. Aymor H. Sanderson and Mr. J. A. Hosker, both of whom, being eligible, offer themselves for re-election. The auditor, Mr. R. H. Marsh, also retires, and offers himself for re-election.

Crystal Palace Electric Supply Company.

The ordinary general meeting of the shareholders of the above company was held under the chairmanship of Mr. J. W. Barclay at the offices, Dashwood House, New Broad Street, on Thursday in last week. A representative of the Electrical Review was informed that the meeting was private, but was supplied with the following report:—

The accounts for the year ending December 31st, 1900, submitted herewith, show that the receipts exceed the working expenses by £3 4s. 1d., without any provision for interest on borrowed capital. The unfortunate boiler explosion in July stopped completely for two months 'the production of current, and deranged the working for the rest of the year, besides entailing a direct loss of £573 17s. 5d., after crediting the amounts recovered from the insurance companies. Under these circumstances the results of the year's working cannot be taken as any guide to future profits. The reconstruction of the station and installation of new plant, referred to in last report, were all but completed by the end of the year, and the company will begin to derive the full benefit of the improvements after the first of this month. The demand for current makes progress, and the consumption in 1901 will, it is expected, show a satisfactory increase over the quantity delivered in 1899. The resolutions passed and confirmed at extraordinary general meetings of the company for reduction of the capital were duly approved by the Courts. By a subsequent special resolution 10 of the new 2s. shares were converted into shares of £1 each, and certificates for these have been issued in exchange for the old certificates. The retiring directors are Messrs. Barclay and Gray, who are eligible for re-election. Mr. David Davidson, the auditor, offers himself for re-election.

Hove Electric Lighting Company.

The directors' report, to be presented at the meeting to be held at Cannon Street Hotel on Monday, March 25th, at 11.30 a.m., reads:—

The directors beg to submit the statements of account and balance-sheet of the company, made up to December 31st, 1900, and have pleasure in congratulating the shareholders on the satisfactory result of the year's working. In common with all other industrial undertakings requiring steam-power, the company's revenue has suffered by reason of the increased cost of coal during the year, but on the other hand the increase in the consumption of electricity has more than compensated for the extra cost of coal.

The progress of the company is best shown by the following statistics:—

Year.	Houses.	Equivalent to 8-c.p. lamps.	Units sold.	Gross revenue.	Net revenue.
1897	397	27,777	268,243	£7,269	£3,602
1898	513	36,967	359,254	£9,480	£5,089
1899	671	44,894	444,499	£12,070	£7,097
1900	802	52 919	539,209	£13,828	£7,715

The result of the year's working is a net profit of £7,715 14s. 5d., to which there has to be added the sum of £845 17s. 9d. balance from the previous year, making a total of £8 061 12s. 2d. After deducting debenture interest paid and accrued, the interim dividend at the rate of 7 per cent. per annum paid in October last, and providing for income-tax, there remains a net balance of £5,161 19s. 1d. to the credit of net revenue account. In addition to the £262 5s. written off the preliminary expenses and installation account, as mentioned in last year's report, the directors have now written off £126 12s. 1d., the balance of the preliminary expenses. The expenditure on general administration, and management expenses during construction, and fees on capital and registration, originally taken to account with the outlay on preliminary expenses, will stand as a final charge against capital. The directors propose to place £2,250 to the credit of the reserve fund, to declare a dividend, payable on April 15th next, at the rate of 9 per cent. per annum for the half-year on the share capital, making, with the interim dividend, 8 per cent. for the year, and to carry the balance of £545 14s. 1d. forward. During the past year the directors have issued 1,000 additional shares at the price of £7 10s. per share, the premium on the issue being added to the reserve fund. With the addition now proposed to be made, the sum at credit of reserve fund will amount to £17,087 17s. The amount (£600) annually set aside for repairs and maintenance, in accordance with the contract with the Hove Commissioners, has proved insufficient to meet the outlays on this account during the past year, in consequence chiefly of the renewal of the company's battery of accumulators. As a result, the balance of £315 12s. 5d. has been taken from this reserve account, which now amounts to £945 14s. 11d. The expenditure on capital account during the year has amounted to £6,862 9s., the total expenditure up to December 31st being £100,523 3s. 9d. The site for a second generating station, referred to in last year's report, has been acquired by the company, and the conveyance is expected to be completed during next month. The plans for this station are nearly ready, and it is intended to commence erection at an early date. In accordance with the articles of association, Colonel A. J. Filgate retires from the board by rotation, but offers himself for re-election. Messrs. J. H. Duncan and Co., the auditors, also offer themselves for re-election.

Robey & Co.

The report of the directors for 1900 states that after writing off £6,671 for depreciation, there remains a net profit of £33,969; deducting debenture interest and adding £2,557 brought forward, there is a balance of £30,214 available for division. The directors recommend a dividend of 6 per cent., adding £10,000 to reserve fund (increasing it to £50,000) and carrying forward £3,422.

Charing Cross, Euston and Hampstead Railway Company.

The half-yearly meeting held on Wednesday at the offices was presided over by Mr. W. E. Jones, who stated that 451 shares had been subscribed for, on which £2 a share had been paid; and the expenditure had been £151, leaving a balance at the bank of £780. He moved the adoption of the accounts.

Mr. Ernest Halsey seconded the motion, which was carried.

An extraordinary meeting was afterwards held, and the Chairman proposed a resolution for raising the capital authorised by Section 37 of the company's Act of 1899, by the creation and issue of new ordinary shares.

Oldham, Ashton and Hyde Electric Tramway.

The directors' report presented to the meeting held at Cannon Street Hotel yesterday, Thursday, reads as follows:—

The directors beg to submit their report and the statement of accounts as at December 31st, 1900. The total revenue for the year amounts to £23,156 3s. 7d., and the expenditure (including (£1,479 16s. 4d. for debenture interest) to £18,196 4s. 6d., leaving a net profit of £4,959 19s. 1d., which added to the amount of £617 12s. 7d. brought forward from the previous account makes an available balance of £5,577 11s. 8d., which the directors propose should be applied as follows:—

Amount to be placed to depreciation fund	£1,000	0	0
Dividend at the rate of 5 per cent. per annum on the cumulative preference shares for the year	2,000	0	0
Dividend on the ordinary shares at the rate of 7 per cent. per annum for the six months ended December 31st, 1900, making with the interim dividend paid on August 15th last, 6 per cent. for the year	2,400	0	0
Balance to be carried forward to next account	177	11	8
	£5,577	11	8

The net profit for the year would have been larger but for the unfortunate strike of motormen and conductors, which seriously affected the traffic receipts during a period of six weeks, and resulted in an additional expenditure by the company of £1,492 12s. 4d., which has been charged against the revenue for the year. The total capital expenditure amounts to £127,681 0s. 2d. The subscribed capital in shares and debentures amounts to £120,000. The directors recommend that powers be taken to increase the nominal capital by the creation of 1,000 ordinary shares and 1,000 preference shares of £10 each, and the necessary resolution which the shareholders will be asked to consider, and, if deemed advisable, to pass, will be found on the first page of the notice convening the meeting. The appeal by the company against the judgment in the action instituted by the Hyde Corporation to prevent the company using the feeder cables which have been laid under the footpath was dismissed, and negotiations are pending between the company and the Hyde Corporation and between the company and the contractors in regard to the matter. The company's application to the Light Railway Commissioners for an order for extensions of the lines was refused by reason of opposition on the part of the local authorities, who are now promoting tramways and light railways in the district. The directors are opposing these promotions by the local authorities so far as they are able to do. The directors propose to take the opportunity of the general meeting to ask the shareholders to alter the articles of association in accordance with the requirements of the Companies' Act, 1900, and the resolution to this effect is contained in the notice convening the extraordinary general meeting. Mr. A. R. Monks has resigned his seat on the board, and Mr. J. Vincent Kitchener has been appointed to fill the vacancy.

Miles Open—	M.	F.	Ch.
Route miles	8	1	1
Single line 5 6 7			
Double line 2 2 4			
Number of passengers carried	4,131,589		
Average receipts per passenger	1·24d.		
Average expenditure per passenger	·88d.		
Proportion of expenses to receipts	65·86 p.c.		
Number of cars in stock	38		

Stock Exchange Notices.—The Committee has appointed special settling days as under:—Wednesday, April 3rd, Edmundson's Electricity Corporation, Limited—13,363 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 6,638 to 20,000. Johnson-Lundell Electric Traction Company, Limited—37,398 shares of £5 each, £3 paid, Nos. 20,008 to 52,581; 52,654 to 53,119; 53,353 to 53,766; 53,814 to 53,850; 55,715 to 58,923, and 59,110 to 59,807. The Committee has also ordered the undermentioned to be quoted in the Official List:—British Insulated Wire Company, Limited—Further issue of 30,000 ordinary shares of £5 each, fully paid, Nos. 40,001 to 70,000: and 30,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 40,001 to 70,000. Edmundson's Electricity Corporation, Limited—13,363 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 6,638 to 20,000; and a further issue of £45,000 4 per cent. first mortgage debenture stock.

Brush Electrical Engineering Company.—The report of the directors to be presented to the meeting to be held on the 29th inst., states that there is an available gross profit of

£61,732. After deducting maintenance, &c., there is a net profit of £24,070; £5,000 is placed to depreciation reserve fund. Capital expenditure to the extent of £68,067 has been incurred. The additions to the company's works and plant at Loughborough are now virtually complete. In order to provide for the expenditure on capital account, 12,500 preference shares of £2 each and 20,000 ordinary shares of £2 each are to be offered to the public. The offer of the B.E.T. Company to issue ordinary shares in exchange for ordinary shares of the Brush Company has resulted in their acquiring 15,584 ordinary shares of the company.

British Columbia Electric Railway Company.—The directors have convened an extraordinary general meeting, to be held in London on 25th inst., as in anticipation of a further increase both in the railway and lighting business, they have decided to purchase additional rolling stock, and to considerably increase the electric lighting plant and make other extensions rendered necessary. To raise funds for this purpose they have decided to make a public issue of the 6,400 preference shares.

County of London and Brush Electric Lighting Company.—The directors recommend payment of a final dividend upon the ordinary shares of 4 per cent. per annum for the half-year ended December 31st last, making 4 per cent. for the year, and on the preference shares of 6 per cent. per annum for the half-year to December 31st, 1900.

W. T. Glover & Co., Limited.—Notice is given that the preference and ordinary share transfer books will be closed from the 18th to the 31st inst., both inclusive, for the preparation of dividend warrants.

Stock Exchange Notice.—Application has been made to the Committee to appoint a special settling day in and to grant a quotation to Central London Railway Company—Scrip certificates of 4 per cent. debenture stock.

Aron Electricity Meter, Limited.—The transfer books of the preference shares will be closed from 25th to 30th inst. inclusive.

National Electric Wiring Company.—The directors recommend a dividend of 4 per cent. for 1900.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending March 15th were £446; corresponding week last year, £421; increase, £25. Total to date, £4,275; corresponding period last year, £3,850; increase, £405. Miles open, 8½. Partly electrical and steam.

Blackpool and Fleetwood Tramways.—The receipts for the week ending March 16th were £180; corresponding week last year £212; decrease, £32. Total to date, £1,574; corresponding period last year, £1,684; decrease, £110.

Bristol Tramways and Carriage Company.—The receipts for the week ending March 15th were £3,481 12s. 6d.; corresponding period last year, £2,718 10s. 11d.; increase, £1,123 1s. 7d.

Central London Railway.—The receipts for the week ending March 16th, were £6,157; previous week, £5,855; increase, £302. Total receipts to date (11 weeks), £66,819. Miles open, 6.

City and South London Railway.—The receipts for the week ending March 17th were £2,021; corresponding week last year, £1,452; increase, (Moorgate extension open) £569. Total to date, £22,154; corresponding period last year, £13,227; increase, £8,927. Miles open, 1901, 4½; 1900, 3½.

Dover Corporation Tramways.—The receipts for the week ending March 16th were £156 13s. 1½d.; corresponding week last year, £135 2s. 1d.; increase, £21 11s. 0½d. Total to date, £1,689 19s. 8½d.; corresponding period last year, £1,586 10s. 4½d.; increase, £103 9s. 4d. Miles of track open, 8; Car miles run, 1901, 4,988; 1900, 4,581. Number of cars, 11.

Dublin United Tramways Company.—The receipts for the week ending March 15th were as follows:—D. U. T. Co., electric cars, £3,168 18s. 6d.; D. S. D. Co., electric cars, £711 3s. 5d.; total £3,880 1s. 11d.; corresponding week last year—D. U. T. Co., electric cars, £2,944 19s. 0d.; ditto, horse cars, £48 18s. 0d.; D. S. D. Co., electric cars, £669 19s. 5d.; total, £3,663 16s. 5d.; increase, £216 5s. 6d.; aggregate to date, £40,144 14s. 7d.; aggregate to date last year, £36,908 11s. 2d.; increase, £3,236 3s. 5d. The mileage worked is 45 miles electrically, as against 42 miles electrically, 2 miles by horses, for the corresponding period last year.

Liverpool Overhead Railway.—The receipts for the week ending March 17th were £1,574; corresponding week last year, £1,340; increase, £234. Total to date, £16,269; corresponding period last year, £15,641; increase, £628. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The latest Stock Exchange bogey is a new issue which is anticipated of a loan of about 50 million Consols in order to cover the final costs of the South African war. Nothing definite concerning this is expected to be heard before the Budget is published, and as Sir Michael Hicks-Beach is not likely to make his statement for another three weeks, the markets will have plenty of time in which to get accustomed to the suspected spectre. Already it has laid a cold hand on investment departments as a whole, and its presence helps to explain the number of losses which we have to chronicle this week in the electrical divisions. In some instances the fall has been brought about by deduction of dividends in the first place, but making allowance for this, prices are mainly dull.

Electric Supply shares are mostly easier, the only exception to the weakness being County of London Ordinary, which are ½ up, thus regaining the position they occupied a fortnight ago. This is due to the declaration of a 4 per cent. dividend on the shares, when the market had been seriously canvassing the possibility of no distribution at all being made for the second half of 1900. A batch of shares is quoted *ex* dividend, and amongst those prices which have recovered the amount are Brompton Ordinary and Preference, and Metropolitan Ordinary. The deductions in the case of Chelsea and Charing Cross Ordinaries led to a further fractional fall. Metropolitan new Ordinary at 10 are *ex* 9d. a share. London Electrics are very weak, and St. James's have dropped 10s.

Now that the metropolitan enterprises have declared their results for the past half year, it is possible to work out the return afforded to the investor in supply Ordinary shares at current prices. We will give a few illustrations:—

Company: Ordinary shares.	Dividend, 1900, per cent.	Price now.	Return per cent.
Brompton and Kensington ..	6	7½	£4 0 0
Charing Cross and Strand ..	9	9½	4 14 9
Chelsea	5½	6	4 11 8
Kensington	12	11½	5 4 4
Metropolitan	6	13	4 12 4
Notting Hill	7	16	4 7 6
St. James's and Pall Mall ..	14½	14	5 3 7
Westminster	10½	12½	4 4 0

It will be noticed that the highest yield is obtainable from Kensington and Knightsbridge shares. The dividend recently declared made a 12 per cent. distribution for the year, as against 11 per cent. paid in 1899, but the net revenue was £1,600 less—a rather curious fact.

The home railway market has had a little light excitement lately in the shape of various reports as to what may happen to the District and the Metropolitan Railways before electricification. Those reports, which relate to acquisition of the lines by an American syndicate, are disdainfully laughed at in the Stock Exchange, although the rumour was considered a sufficiently strong peg whereon to hang a slight rise in Districts, which now stand at 28. Metropolitan Ordinary is the turn better at 73. Electrical lines proper display no variation. The Vibration Committee's report is awaited with some anxiety, despite the fact that no fear is expressed with regard to its conclusions. Promoters of tube companies are anathematising the Central London, since the vibration scare has made it unprofitable for them to offer their wares to the public until the question is settled. At the Baker Street and Waterloo meeting the report and accounts were adopted without any cavilling, but the position seems certainly hazy. The market quotation for the shares is still purely nominal.

Good buying of British Electric Traction Ordinary shares has brought about a rise of £1, and market gossip says the price will go much higher between now and June, when the next report will be due. From the character of the buying it looks very much as if the new financial backing secured by the company for the guaranteeing of its recent issue of shares were making its influence felt. It must be remembered that the guarantors have the call of the company's unissued capital at £13 per share. In the tramway market the Oldham, Ashton and Hyde report is favourably received. It tells of a 6 per cent. dividend for the year. The British Columbia Electric Railway proposes to issue 6,400 of its Preference shares hitherto held in reserve, and the suggestion is to be considered at the meeting on Monday, March 25th. More money is required for the purchase of fresh rolling stock, and the extension of the electric lighting plant.

In the manufacturing division, Brush shares are unchanged, in face of the 5 per cent., instead of last year's 6 per cent. dividend. Henley's, quoted *ex* 16s. dividend, are a pound down, but the Preference are unaltered, although *ex* 2s. 3d. per share. British Insulated Wire have reacted to 10½ again, principally on movements in the price of copper—Willans & Robinson Ordinary are 12, the Preference 7. Babcock & Wilcox Ordinary and Preference remain at 3½ and 1⅝ respectively. Edison & Swan are very dull, the market disliking the company's financial position. Electric Constructions are also flat; the unfavourable report being in process of discounting the dealers.

Telegraph securities are exceedingly quiet, and the only changes worth mentioning are slight declines in Anglo-American and Eastern Telegraph stocks. Direct Spanish Telegraph shares have been put down to 3½. The company has had a singularly unfortunate year as regards fracture of its lines. The dividend is, however, maintained, and as the traffic receipts increased while the expenses were lowered, the company is evidently well managed. National Telephone shares are rather easier, and the 4 per cent. Debenture is down to 1 discount.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotations March 13th.	Closing Quotation March 20th.	Business done during week ended March 20th, 1901. Highest.	Lowest.
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —102	99 —102	...	...
119,700	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	55 — 65	55 — 65	...	...
822,700	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½%	51 — 54	50 — 53	50	...
3,088,540	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	95 — 97	94 — 96	96¼	94
3,088,540	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	8½ — 8¾	8 — 8½	8½	8
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	...	3 — 3½	3 — 3½	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	102 —104	103	102¼
16,000	Cuba Telegraph	10	8 %	7 %	...	7½— 8½	7½— 8½	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	16 — 17	16 — 17	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3½— 4½	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 — 104%	100 —104%	...	...
60,710£	Direct United States Cable	20	3½%	3 %	3 %	9⅜— 10¼	9⅜— 10¼	...	...
108,300	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	144 —149	143 —148	145½	143
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	94 — 97	93 — 96	94	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	113 —117	113 —117	115	113½
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	14½— 14⅝	14½— 14⅝	14⅝	14 5/16
50,000	Do. Nos. 250,001 to 300,000 (iss. at £3 pm. all pd.) ...	10	...	...	...	13⅜— 14¼	13⅜— 14¼	13⅞	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	111 —116	111 —116	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	101 —104%	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	...	9⅜— 10¼	9⅜— 10¼	10 1/16	9⅜
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14⅜— 15½	14⅜— 15½	15	...
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	...	32 — 34	32 — 34	32⅜	...
82,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	47 — 51	47 — 51	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼— ⅛	¼— ⅛	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	¼— 1	¼— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3½— 3⅝	3½— 3⅝	3⅝	3⅜
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	11½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	10 — 12	11½	10½
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4½— 4⅝	4½— 4⅝	4 9/16	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	92 — 95	92 — 95	100	97
500,000	Do. 4 % Deb. Stock Red.	100	...	...	4 %	98 —101	97 —100	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	...	7½— 8½	7½— 8½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	124 —129	124 —129	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	4½— 5	4½— 5	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	103 —106	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	97 —100	97 —100	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13⅜— 14½	13⅜— 14½	14½	13 13/16
75,000	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	101 —104	101 —104	...	...
348,777	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	102 —105	...	...
88,321	West India and Panama Telegraph	10	2 %	8%	...	⅝— ¾	⅝— ¾	11/16	⅝
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	6 — 7	6 — 7	6⅝	6
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	5 — 7	5 — 7	5	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	103 —106	103 —106	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7 — 8	7 — 8	7⅞	...
12,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8 — 9	8 — 9	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9½— 10½	9 — 10 xd	9½	...
20,000	Do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 5⅝	5 7/16	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	6 — 6½	5⅝— 6½	6	...
150,000	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	...	7½— 8½	7½— 8½	8 1/16	8
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	...	...	13 — 14	13 — 14	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	4 %	4 %	7½— 8½	8 — 9	8½	8⅛
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	...	...	11½— 12½	11½— 12½	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	106 —109	106 —109	107½	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	7 %	...	...	4⅜— 5½	4⅜— 5½	...	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	103 —106	103 —106	104½	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 2	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	3 — 4	...	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —101	98 —101	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	12½— 13½	12½— 13½	12 13/16	12⅝
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	110 —113	110 —113	...	...
250,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	97 —100	98½	97
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½— 16½	15½— 16½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	13½— 14½	14 5/16	14
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	13 %	10½%	12 — 13	12 — 13	12⅝	12

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked † are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‡ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation Mar. 13th.	Closing Quotation Mar. 20th.	Business done week ended Mar. 20th, 1901. Highest	Lowest
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	8 — 9	8 — 9	...	...
300,000	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	91 — 95	91 — 95	...	...
45,000	British Electric Traction	10	6 %	...	...	14 — 15	15 — 16	15 9/16	15 5/16
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	11¼ — 12¼	12½ — 13½	12 7/16	12 3/16
350,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	120 —123	120 —123	...	...
85,000£	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	1/16 — 3/16	1/16 — 3/16	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	3/16 — 5/16	3/16 — 5/16	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	85 — 90	85 — 90	...	...
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	11 — 12	10 — 11 xd	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅝ — 6½	5⅝ — 6½	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1⅝ — 1⅞	1⅝ — 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2⅛ — 2⅜	2⅛ — 2⅜	2¼	...
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	...	...
108,710	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	101 —103	101 —103	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	15 — 16	15 — 16	15⅜	15⅝
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
206,297	Central London Railway, Ord. Shares	10	...	...	...	8⅞ — 9¼	8⅞ — 9¼	...	...
78,703	Do. do. Pref. half-shares	5	...	...	...	4⅜ — 5½	4⅜ — 5½	5	4⅞
78,703	Do. do. Def. do.	5	...	...	...	4 — 4½	4 — 4½	...	...
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1½%	46 — 50	46 — 50	48½	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	4 — 5	4 — 5	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	...	3¼ — 3⅜	3¼ — 3⅜	...	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	1½ — 2	1½ — 2	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	...	3½ — 4½	3 — 4	...	...
344,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	88 — 90	88 — 90	89	88
100,000	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	96 —100	96 —100	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅞ — 2⅛	1⅞ — 2⅛	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2½ — 3	2½ — 3	...	...
182,500	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	101 —104	101 —104	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 11	10 — 11	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	16 — 17	15 — 16	15⅞	15⅜
35,000	Do. do. do. 4½ % Pref.	5	7 %	...	...	5½ — 6	5½ — 6	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	107 —111	107 —111	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21½	21 5/16
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	102 —105	102 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3⅜%	3½%	7⅜ — 8¼	7⅜ — 7⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13¼	13 — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	38 — 42	38 — 42	39½	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	101 —104	101 —104	104	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	...	11 — 12	11 — 12	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	93 — 96	93 — 96	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Brompton and Kensington, 4½ % Debentures of £100, 101—104.
Consolidated Telephone Construction and Maintenance, 3/—4/-
National Electric Free Wiring, 12/6 paid, 5/16—11/16.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16½.
Do. do. Pref. (£10 pd.), 10—10½.
* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 11—12; 1st Preference Cumulative 6 % £5 (fully paid), 6½—7 Debentures, 101—104. Dividend, 1900, on Ordinary Shares 12 %.
*T. Parker, £10 (fully paid), 16½.

Bank rate of discount 4 per cent. (February 21st, 1901).

MARKET QUOTATIONS, Wednesday, March 20th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17 10	£17 10	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	..
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8¾d.	8¾d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	64/-	64/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5s.	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£8	£8	..
,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£80 to £145	£80 to £145	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	¼d. dec.
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8¾d.	8¾d.	..
c ,, Wire, basis	per lb.	8d.	8¼d.	¼d. dec.
c Copper Tubes (brazed) ..	per lb.	11d.	11d.	..
c ,, ,, (solid drawn) ..	per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) ..	per ton	£84	£85 10	30s. dec.

METALS, &c. (*continued.*)		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£84	£85 10	30s. dec.
g ,, Rod	per ton	£84	£85 10	30s. dec.
c ,, (Electrolytic) Bars ..	per ton	£82	£82	..
c ,, ,, Sheets ..	per ton	£90	£90	..
c ,, ,, Rod ..	per ton	£84	£84	..
c ,, ,, H.C. Wire	per lb.	9¼d.	9¼d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/6½ to 3/7	3/6½ to 3/7	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	45/10½	46/2	3½d. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£10	£10	..
g Lead, English Ingot	per ton	£13 to £13 2 6	£13 10	7s. 6d. dec.
g ,, ,, Sheet	per ton	£17 15	£17 15	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 2 6	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4	£4	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£118 10 to £119 10	£121 10 to £122 10	60s. dec.
g ,, foil	per lb.	1/6	1/6	..
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	9d.	9¼d.	½d. dec.
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14	£14 10	10s. dec.
k Zinc, Sh't. (Vielle Montagne bnd.)	per ton	£21	£21	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Jackson & Till. i Messrs. Boiling & Lowe. j Messrs. Henry C. Yeo & Co.

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INSTITUTION OF ELECTRICAL ENGINEERS (MANCHESTER SECTION).

THE APPLICATION OF STEAM POWER TO THE GENERATION OF ELECTRICAL ENERGY.

By John S. Raworth, M.Inst.C.E.

(Paper read March 12th, 1901.)

The best point of view from which to study an object is not usually the nearest; only few of the beauties of the sea are visible to the man who is up to his neck in it; we, therefore, who work amongst steam engines and dynamos must occasionally, like the painter, step back a few paces in order to obtain a better view of the general effect and tendency of our work.

There is a section of the public, by no means small, that imagines that electricity in itself is a source of power, and that the electric century will soon get along quite well without either steam or coal.

At present there is no prospect of any such development, on the contrary, electricity has made steam power applicable to many purposes, for which in the past it was useless, and to that extent it has increased the demand for steam engines; moreover, since it has enabled us to distribute power wholesale or retail, as required, from a common source, its tendency is to increase the size of the individual units to an extent beyond the limits of our comprehension.

The first effect of the invention of the dynamo was to raise up a demand for small steam engines, which continued active during several years, because the early efforts of electricians to build dynamos of large sizes were not rewarded with success. Even so late as the year 1893 the City of London Electric Lighting Company could not obtain in England or America machines of 500 kw. output that were entirely satisfactory, though from that date forward progress has been very rapid, so that we now find in New York the power station of the New York Elevated Railway Company contains 11 units each of 7,000 h.p.

The history of the steam engine improvement in this country during the seven years is very remarkable. The established builders of large engines in Lancashire and Yorkshire have stood aside and have left comparative outsiders to wrestle with the problem. Willans, Belliss, Brush, Browett, Ferranti and Maclaren have each on independent lines endeavoured to find an answer to the question, "How shall we drive a dynamo?" A few years ago the big engine builders appeared to think the electric engine beneath their notice, but now electricity demands engines bigger and better than Bolton can build, with the result that Allis and Sulzer Bros. have both succeeded in pulling plums out of the British pie.

I do not affirm that either Allis or Sulzer engines are better than our Bolton engines, but their buyers have been made to believe them to be better.

I have no experience of Continental engines in work, but of American engines I have had more than enough. The conclusion I have come to is that on the average they are strong plain engines, with good juvenile appetites and a rather abnormal tendency to develop internal complications attended sometimes by external eruptions.

Some electrical engineers seem to think that it is only necessary to order a foreign built engine to escape from all their woes, but they are wrong, there is no escape for an engineer, he must climb over his difficulties, he cannot dodge them.

It is a curious and remarkable fact that whilst in different countries dynamo design has shown a strongly marked tendency towards uniformity, steam engine designs have been and still are divergent. In England we have the three-crank high speed vertical as the leading type. In America the side by side compound horizontal or vertical slow speed engine predominates, whilst in Switzerland and Germany there is a marked tendency to develop the compound tandem engine on one crank.

The English engine is the cheapest, and gives theoretically the best turning effort.

The Swiss engine is the most economical in steam consumption, and the most wasteful in land and buildings.

The history of the development of the English pattern is very interesting. The early attempts at "electrical undertaking," that is to say, the distribution of electrical energy for all purposes within the boundaries of a parish or municipality, were made in London, and, as you know, the first generating stations were constructed in basements beneath and amidst valuable property inhabited by nervous, and sometimes impecunious, people.

There were few good engines suitable for the purpose, and the best of the few was the Willans, but its speed was high, and its moving parts heavy, hence came vibration, followed by claims, writs, lawsuits, and compensation.

In those days the Willans engine was a two-crank engine, equivalent to a single-crank double-acting, and it would probably have remained in that stage of its development if the vibration trouble had not become acute, but in 1895 Captain Sankey and Mr. Mark Robinson produced their paper on a method of preventing vibration in steamships, in which they showed that a three-crank engine provided a good practical solution of the vibration problem, and gave a more equal turning moment than the two-crank arrangement; this latter consideration was, however, of trivial importance, because no trouble had arisen with the earlier engine in this respect. An experiment carried out by Mr. Mordey at Thames Ditton in 1887 or 1888 showed that alternators direct-coupled to Willans two-crank engines worked perfectly in parallel. The three-crank engine, therefore, exists by virtue of its internal balance. This is its good point; its bad point is lack of economy, due to three causes—first, leakage length of piston ring 73 per cent. more than that of single-crank engine of same stroke and revolution, 73 per cent. more area of cylinder walls, and the almost insuperable difficulty of applying automatic expansion.

The question will arise to your lips, Why is it difficult to apply automatic expansion when Maclaren does it quite easily? The answer is that the Maclaren engine is not one of the class described—it has three cranks, but it is not balanced either in turning moment or in inertia effect; it is simply a triple expansion marine engine with three cylinders, three cranks, and an expansion governor, whereas the modern three-crank engine has a complete compound or triple tandem engine on each crank, consequently the turning moment and the balance is nearly perfect at all loads. With this engine we have either six or nine cylinders, and internal packing rings too numerous to mention.

This engine has some excellent qualities. It is suitable for use in positions where vibration cannot be permitted, and it enables the designer to use a shorter stroke and higher speed of revolution than with any other of the existing designs of reciprocating engines. On the other hand, it is less economical in steam than the same build of engine on one or two cranks, and it passes the wit of all engineers, save Captain Sankey, to make its expansion automatic. You are well aware that the Willans engine has had automatic expansion applied to it in two-crank and three-crank patterns, but we hear no more of it; we may, therefore, conclude that except as a triumph of human ingenuity, this elaborate and most artistic device has sunk into the region of things that are not.

I have referred to the excellently equal turning moment of the "three-crank engine;" this is no myth in the Willans and Belliss engines, and in all engines of similar design it is a substantial fact, and if it had fallen to the lot of those engines to have been called upon to work at 70 to 120 revolutions per minute, it would have been an *important* fact, but their lot has fallen in pleasanter places, their speed of revolution is usually between 200 and 500 per minute, where all questions of turning moment vanish, and it becomes impossible to distinguish between the results of a single-crank and a three-crank engine.

I have no experience with three-crank engines, but I have no reason to doubt that their results, as judged by steady current, are nearly independent of speed; but with single and two-crank engines, the result of my very varied experience is that there is no happiness under 200 revolutions per minute with any size of engine and above that speed all difficulties vanish.

At the Wandsworth station of the County of London Company there are six 300-h.p. engines driving Mordey alternators in parallel. The result is perfect, although all the engines have single cranks. Moreover, there is no apparent difference when the exhaust is taken to the condenser or the atmosphere, though the effect of changing from one to the other is to destroy the balance between the upstroke and the downstroke. The speed is 213.

I submit that this example settles the question of the suitability of single cranks. There is a very general belief that with two cranks at right angles the turning effort is more equal than with a single crank. At slow speeds the popular belief is justified by experience, but at high speeds there is not much difference between them, so little indeed that in a two-crank *vertical* engine it is better to set the cranks opposite than at right angles.

Mr. Edgar Ingram, at Bournemouth, received a two-crank Universal engine from the Brush Company, in which the cranks were at right angles, but on trial the parallel running was found to be imperfect. He then coupled the cranks at 180° with this result, that the parallel running is now quite satisfactory.

In a horizontal engine the improvement would not be so evident, the insistent weight of the moving parts on the cranks being eliminated.

In this connection it is worthy of notice that builders of long stroke horizontal engines very rarely balance their cranks. The effect of the weight of the crank on the turning moment of the engine is small, but it is definite, and it can be balanced with ease and certainty; it is therefore desirable that it should be done in all cases. In engines with two opposite or three equally spaced cranks, the cranks balance each other.

Now that interurban generating stations have become nearly obsolete, the vibration question has sunk into comparative insignificance, and we may well ask ourselves the question whether it is desirable to go on developing the three-crank engine with fixed expansion and six or nine cylinders, when better results can be obtained with more simple and less expensive designs.

In considering this phase of the subject, there is, as usual, a compromise, and it is worthy of note that it has received very little attention.

At an early stage I mentioned that a three-cylinder triple engine on three cranks is not a good high speed arrangement, on account of the large size of the low-pressure piston, and the unequal distribution of effort at varying loads.

A three-cylinder compound engine on three cranks possesses these disadvantages in a much smaller degree. The two low pressure cylinders are only slightly larger than the high pressure, the weights of the lines of parts can easily be made equal, the effort of each cylinder at varying loads is much less diverse than in the triple, and it is a simple process to apply automatic expansion.

It is probable that an engine on these lines has been built, but I have never seen one except in marine practice.

It is very rarely that a triple engine possesses a practical advantage over a compound in electrical work, and this already rare advantage will disappear with the general adoption of superheating.

Mr. Wilhelm Schmidt tells me that he can obtain the best results with a compound engine and hot steam. Having these facts in view, I shall be very much surprised if the three-crank three-cylinder compound does not become a favourite for large units of from 2,000 to 5,000 H.P. English engineers and even Oldham aldermen have at last got over their objection to enclosed engines.

They reluctantly recognise the fact that at 300 revolutions per minute the connecting rod ceases to be a thing of beauty, and that oil is better inside the engine than all over the floor.

It has taken 20 years to get to this point, but having arrived we shall never go back. The Swiss engines are very impressive from the Bolton point of view, the cylinders alone at the Zurich power station are 24 ft. long; I think if I had a cotton mill and a large family of girls I would have one of those engines just for luxury, it would be quite as seductive as a picture gallery and less expensive.

Lancashire does not recognise the high speed enclosed engine; it has not yet been "introduced," but it will be soon, the 1,500 H.P. engines of Browett & Lindley, at Salford, will leave their card.

Let me try to clear this question:—

High speed of revolution necessitates enclosure.

High speed increases economy. (See Willans's papers, Civil Engineers, 1888—1893.)

High speed improves turning effort.

High speed reduces prime cost of engine, land, and buildings.

High speed does not involve abnormal wear. (See Mark Robinson's paper, Electrical Engineers, 1897.)

The designing of enclosed engines is an art: it does not consist in simply casing an engine with cast-iron. The engine, though enclosed, must be accessible, and provision must be made for the continuous lubrication of every joint.

Anyone who has attempted to design an enclosed engine will understand the difficulties, of which there are many working examples.

The application of indicating gear to high speed engines has only been partly faced; indeed, it is nearly impossible to take a satisfactory set of diagrams from some of the six and nine-cylinder three-crank engines.

There are two principal methods of lubrication employed, which may generally be divided into the Willans and the Belliss systems.

Willans depends on the splash.

Belliss pumps the oil through the bearings.

Both give good results, but Belliss obtains much higher efficiency at light load than Willans—this may be partly due to flush of oil, but it must be remembered that the Willans engine has no such thing as light load on the bearings, the moving parts are abnormally heavy, and there is no cushion on the down stroke, consequently the bearing surfaces are subject to severe pressure, even when there is no external load; it is quite possible, therefore, that the coefficient of friction may be nearly, if not quite, the same in both engines. I have tried both systems, and have found no difference between them, although I get 15 lbs. pressure in the oil pipe, I do not believe that there is any pressure between the bearing surfaces, except the pressure that comes through the connecting rod; nevertheless, a constant flow of oil through the bearings is good, as it washes out the dirt.

The question of automatic expansion is constantly before us, and although it is bound to conquer in the end, the victory has been very much delayed by the advent of the three-crank engine.

Captain Sankey showed in his paper read before the Institution of Mechanical Engineers in 1895 that automatic expansion is always more economical than throttling except at light loads.

At light loads throttling is superior in economy, therefore he devised his ingenious arrangement for expanding down to 14 lbs. mean pressure and then throttling. The moral of this is that trip gear for 20 years has been obtaining our admiration on false pretences—it is pretty, but not economical. The simple shaft governor, despised because it shows throttled diagrams at light loads, is now discovered to be theoretically and practically perfect.

I have only one word more to say, and that is, that we now hear no more about special engines for traction purposes, the great fly-wheel craze has burnt itself out, English engines built for electric lighting purposes are driving tramcars most successfully, the appalling descriptions of "destructive stresses" invented to frighten English buyers into purchasing American engines are to be found lying in the journals of the Institution.

There let them lie.

Discussion.

With regard to Mr. Ingram, Mr. Raworth said that he had had a letter from him in which he had corrected his views as to the reason for altering the two-crank engine at Bournemouth referred to in the paper. Mr. Ingram wrote that he altered the 650-H.P. engine from 90° to 180°, as he wished to prove that the plant would run as well in parallel with the cranks at 180° as at 90°, because he wanted a similar engine governed by automatic expansion, one governor driving the two high-pressure valves when the weights of their motion-parts were balanced against each other. With regard to the clause of the paper commencing:—"Having these facts in view, I shall be very much surprised if the three-crank, three-cylinder compound, &c.," he, Mr. Raworth, had learned that the large engine, built by Musgraves for Glasgow, was one of that class.

Mr. S. V. Clirehugh opened the discussion, remarking that it seemed that in general, Mr. Raworth was laying down the view that below 200 revolutions they must have three-crank engines. He made a statement which he (Mr. Clirehugh) thought required a little modification, that with single or two-crank engines below 200 revolutions per minute, there was no happiness. He took it Mr. Raworth meant between engines of little fly-wheel capacity. Lancashire and Corliss engine makers would be up in arms on that point. But the main point was that Mr. Raworth dismissed triple-expansion engines in a very summary manner. He said Mr. Schmidt could get better results with compound engines and hot steam than with triple-expansion engines. They knew that to be true. But they were only on the eve of using superheated steam at all. So far, they had only played with it. It was generally the custom to put their superheater behind the uptake of the boiler, and their superheated steam was generally dissipated before it actually got to the engine. It was merely a steam dryer, and a very useful one, but nobody in this country had tackled the question of superheating at the number of degrees at which Mr. Schmidt obtained his economies. He (Mr. Clirehugh) believed it would come, but he quite believed it would take years to become universal, and that they would all of them have very painful experiences on the subject. Another point was that they knew Mr. Raworth to be the apostle of automatic expansion, and very rightly to be working to that end and pointing out the disadvantage of triple-expansion engines under varying loads. They were all trying, and he hoped succeeding, to run their engines at full load, and if they ran them at full load, they had as good a turning moment as with any engine. It was obvious, if they kept their engines at full load there was no advantage in having automatic expansion. Mr. Raworth said, and possibly rightly, that engines of two cranks under 200 revolutions were unsatisfactory. They found that if they wanted engines for continuous work, they must not go beyond 200. The engines for continuous use were far below suitable dynamo speeds; now they were wanted far above them.

The Chairman observed that with reference to the remark as regards the proper speeds of dynamos, that was the subject on which a paper was to be read at the meeting a fortnight hence by Mr. Shaw, and he trusted Mr. Clirehugh would be there to hear it.

Mr. T. Browett was quite in agreement with Mr. Clirehugh as to the effects of compound engines. What Mr. Schmidt said he could do they had to take on faith, and it was a fact that they had no engines working in this country with anything like the superheated steam instanced. Until it was proved to be a success, there must be a very considerable feeling for the treble. The treble was ready to work with, and gave the very best results under the conditions which do exist at electric stations. The trend at the present moment appeared to be, from a number of inquiries he had made, for treble engines. He thought there would be a demand for those engines. After it was proved that an engine could be run successfully with superheated steam they would still be the fashion, for nobody would think of putting superheaters in a station and getting hot steam unless they found that their engines were very suitable for working at the high temperature. If it were found that the engines were not suitable for working at the high temperature, then treble engines would be required again. On the question of turning moment, a good deal had been said. He only wished to point out that possibly the turning moment would be more even with a treble engine than it would be with an automatic engine. He did not know that three-phase plant required a greater uniformity of turning moment than ordinary alternators. They used to think it did, and people used to give them one-third of 1 per cent., one-fifth of 1 per cent., and so on. It was all very well to calculate those things and say: "Can you do this? How will it come out?" They said, "Oh yes!" Well, if it came out all right it was right. He would like to ask Mr. Raworth if he ever ran any three-phase machines, and secondly, if three-phase required any greater steadiness than would be required by ordinary alternators?

Mr. A. B. Mountain said that one point in the paper was of interest. Mr. Raworth had referred to high-speed plant as if it were the plant to pull down cost. He (Mr. Mountain) had lately been obtaining tenders, and had found that high-speed plant cost more than low speed. He was quite certain Mr. Raworth was right in saying that they would have to make special engines for superheated steam. As regards guarantees, he thought they were not worth listening to; what they wanted were actual tests.

Mr. Lindley had not found very much in the paper which he could raise as points in the discussion. He could only say that the speed of 200 revolutions a minute seemed to have something in it. He knew one engine which was fitted with a heavy fly-wheel, and ran at 160 revolutions, and it had never run satisfactorily. As regards the treble, it might be a very good engine, but he did not think they need labour the advantage it had with respect to turning moment. As regards the turning moment of the compound of the marine type, the turning moment was better than in the vertical engine. He thought that they would find that the want of uniformity was due to the heavy governor, and that right-angled cranks were better than single cranks. As regards superheated steam, they would some day know about having to alter their engines to deal with superheated steam, unless gas engines knocked them out in the meantime. They must not forget in dealing with the economies of superheating and with Mr. Schmidt's results that they must compare Mr. Schmidt's system against the ordinary system; they wanted a Schmidt engine, a Schmidt boiler, a Schmidt superheater so that unless they had the more complete statements of the all-round economies of the Schmidt system they could not draw a useful comparison between the engine and the working of the present day.

Mr. Giles noticed that Mr. Raworth made a great point of equal turning moments. Unequal turning moments were not altogether of such great importance when they were driving any

class of machinery. His own experience of equal turning moments was confined to a three-crank compound engine, a single-acting engine. It seemed to have given a better result than an equal cranked double-acting engine. The larger powers they were asking now, had brought the question into a very different position from that it was in some time ago. With respect to superheating, when they got to that degree of superheating that they all wanted to arrive at, when they were working with dry steam the oil question would dispose of itself, and he thought that they ought to recognise that one reason for the satisfactory working of those high-speed engines had been that with a good oil, superheated steam had been of considerable advantage to that type of vertical engines.

Mr. Douglas thought the comparison between compound engines and triple-expansion engines was one of considerable interest. Superheating was a question which interested him, and he might say that for some months past he had been watching the working of engines developing over 800 H.P. They got as much as 200° of superheating at the boiler, and it was perfectly convenient with the amount they were getting at the cylinders. They thought that one way they could get economy was that the superheated steam might be used to heat the steam between the first and second cylinders, and between the second and third in triple-expansion engines.

Mr. Stead and Mr. Aitchison having spoken briefly, Mr. Raworth replied illustrating differences in expansive working by indicator diagrams on the blackboard.

At the close of discussion a vote of thanks was passed to Mr. Raworth for his paper, and a vote of congratulation, moved by the Chairman and seconded by Mr. Raworth, was passed to the Council of Owens College, the day, March 12th, being the day of the Jubilee of the opening of the old college buildings in Key Street, now used as the County Court.

COMBINED TROLLEY AND CONDUIT TRAMWAY SYSTEMS.*

By A. N. CONNETT.

In many cities where the overhead trolley is or will be admitted on surface tramways, there often exists a street or a central zone where it is or will be expressly prohibited. The electric motors, with which the car is equipped, must therefore be furnished with current from a source other than the overhead wire along a part of its route. There are three means of solving the problem:—(1) Accumulators; (2) Surface contact; (3) Open slot conduit.

It is not the purpose of the author to discuss the first two systems. As the result of his experience with accumulators he would advise that, if in a given case their installation should seem to be advisable, the contract should be drawn in the form of a rental for the batteries, on the terms of paying a fixed sum per automobile car-mile for their use; this sum should include the entire cost of maintenance and renewal of the batteries for a fixed period. Penalties should be inserted in the agreement for each trip lost, due to failure in the working of the batteries; and their electrical efficiency should be guaranteed up to a certain standard, below which the excess waste of energy should be paid for at an agreed rate per ampere-hour. This method has been employed in France and in Germany with good results. It seems the best devised to protect the user from a poor form of battery for a given work, and at the same time to ensure the upkeep of the batteries in the best possible condition; this last is to the evident advantage of both buyer and seller. The batteries should be placed under the car body if possible; if this is not done, the acid fumes are disagreeable to passengers, and the effect will be a diminution of receipts and numerous complaints.

If a surface contact system should be decided upon, the choice of one of the many systems will require careful study. If the number of cars using the portion of track to be equipped with this system is large, and the comparative length of such portion of track is small, it will be found that the cost of the car equipments for a system where the cars carry the magnets is relatively excessive, and that a system employing a magnetic switch for each contact point will be much cheaper. With the condition of a relatively great importance to the surface contact portion of a line, this conclusion as to first cost might easily be reversed. The vital questions of working, maintenance, and safety, have to be given the most careful consideration, with the disadvantage that there is at present very little to be learned from experience on actual working lines, which are either too few or too recently installed.

There should be no hesitation about adopting the conduit, where financial and constructional conditions make it possible, for this system has proved itself to be workable. It has passed entirely beyond the experimental and uncertain period, and can now be adopted without hesitation for the propulsion of cars. It can fail completely, but even partial failure will be the fault either of design or of construction, or of both.

The problem of adapting the plough and track mechanism, to change from the overhead line to the conduit system or *vice versâ*, has been satisfactorily and carefully worked out on several different general principles. In America, where the conduit has been generally adopted in the cities of New York and Washington, the problem of a mixed line has received very little attention. On the Continent there are a number of cases of this kind, and they are all worthy of attention, the problem having received in each case careful study. This, in the author's opinion, is only one instance in several, where European tramways offer now a much more fruitful field for study than American tramways, especially so to the engineer called upon to instal a system in Europe under European conditions and requirements.

The first question to be solved in a conduit construction is the conductor system, to which is intimately connected the manner of making contact. With the limited clearances in a conduit, there can be no other practical method than the one of installing rigid conductor bars, to which the original Buda-Pesth conduit owes its success.

The next question is whether the conduit shall be side slot or centre slot construction. If the engineer has his choice, he will undoubtedly adopt the latter type of conduit. On the Continent there is an objection in some of the cities on the part of the municipal authorities to the centre slot. Therefore in Buda-Pesth, Berlin and Brussels only the side slot is allowed, while in the cities of Lyons, Nice and Bordeaux, the centre slot has been or is being installed. There are some short stretches of centre slot in Paris, but the reasons for this were exceptional, and in general this city may be classed in the first category also, 95 per cent. of the conduit mileage there being side slot. Of the 45 miles of conduit electric railway constructed in four European cities and one American city with which the author has been associated as chief engineer, 30½ miles are of the centre slot, and the remaining 14½ miles are of the side slot type. His original opinion of the greater advantages of the centre slot construction has been somewhat modified by experience, but he still believes that from an operating standpoint the centre slot is the better construction.

The inherent difficulty with the side slot is the switch at the junction of two slots. With the centre slot a comparatively light movable tongue can be hung or pivoted to the fixed tongue, its use being simply to guide the plough. With the side slot the tongue is much stiffer and heavier, because it must also guide the wheels of the car and support them in one position; that is, the entire tongue is movable, and its upper surface from point to heel must be level with the wheel rail. At its point it should have a certain thickness to give mechanical strength. This should be not less than ½ in., which, added to the 1 in. minimum width of slot, gives an opening of 1½ in., which is gradually reduced to 1 in. in a length of about 3 ft. In the centre slot construction the normal slot width of, say, ¾ in., is increased in a length of about 8 in., and the maximum increase is about ¼ inch. An objection to the side slot is that the flanges of the wheels throw water and mud into the conduit and on to the plough. Another is that the slot rail being also a wheel rail should have a vertical web, which diminishes the distance across from rail to rail on the line of their base level, thus limiting the plough construction, and also making the conductor bars invisible from above, which renders the finding of faults more difficult. The principal trouble with the side slot conduit is that connected with the switch, and it can be avoided by a special construction, which will be explained latter. The advantages of the side slot conduit are that the additional band of iron in the street required by the centre slot rails is avoided, and that the maintenance of the paving is thereby simplified, every joint of a rail with the paving being a source of weakness in the life of the latter.

The first line equipped in New York City used a built-up insulator, a bolt being covered with an insulating compound; it failed, and the type of insulator which had proved so successful at Washington was adopted. In Brussels the type of insulator used is a bolt surrounded by a rubber compound. This is subjected to a severe piercing test with a Ruhmkorff coil before being accepted. These insulators have been fairly successful, but they are expensive, and they may also deteriorate by exposure to the atmosphere. The iron-clad porcelain insulator is strong, durable, and cheap. There can be no hesitation about its use. The insulators should be vertical, so that they may not offer the chance for the accumulation of dirt, which can easily happen with one horizontally placed. The first Buda-Pesth road had this fault, but it was rectified in the later construction in that city.

Assuming a vertical iron-clad porcelain insulator, the method of attaching it to the conduit construction becomes important, the depth of the tube being somewhat dependent upon this. For the sake of simplicity it should be fastened to the metallic structure, which has the further advantage of keeping the conductor bars at the same distance from the wheel rails, except in the special case of a centre slot conduit where the yoke construction does not permit the carrying of the wheel rails. The extreme positions of the insulator are, first, with the upper surface of the insulator as near the street surface as it can be for mechanical protection, or, say, 2 ins.; secondly, with the upper surface of the cast-iron insulator cover bolted directly to the bottom flange of the slot rail. Fig. 1 is an example of the former case. The insulator could have been reduced in vertical height so as to have carried the conductor bars higher, but this height is limited by the safe insulation distance required between these bars and the slot rail. Assuming this distance 3½ ins.—the depth of yoke-seat diminishes it by about 1½ ins., leaving 2 ins. of air-gap—the top of the conductor bars will be 10½ ins. from the top of a 7-in. high slot rail. Fig. 2 is an example of the second case with the same slot rail. The insulator has been reduced in vertical height to the safe limit of mechanical strength. The corresponding distance to top of conductor bar is 14 ins., or a gain of 3½ ins. in the conduit depth for the first method of construction.

If the insulators are carried close to the street level they must be

* Abstract of paper read before the Institution of Mechanical Engineers on 15th inst.

protected by metallic covers, which in Europe are considered objectionable, and in some cases they are absolutely forbidden by the authorities, as in Paris. Therefore the second method is the

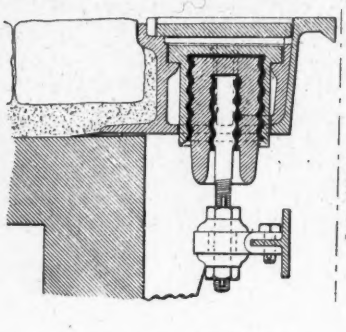

Fig. 1.—In Washington.

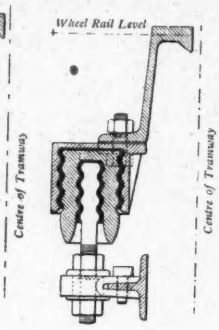

Fig. 2.—In Paris.

Insulators and Suspended Conductor Rails (Central Conduit).

only one that can be used in such cases. Perhaps it should be said that the insulators are protected by metallic covers in the second case; but these are paved over so that the street surface is in no way altered in appearance by their use.

As just explained, the conductor bar carrying height is arrived at by adding the depth of yoke seat and the air-gap to the height of the slot rail. It is possible that the height so arrived at will not give the necessary distance for a vertically hung insulator and its mechanical protection. In this case the insulator determines the height. When this distance is determined, the height of the bar itself, with the necessary clearance to the bottom of the tube, is added. The distance so determined gives the conduit depth. The

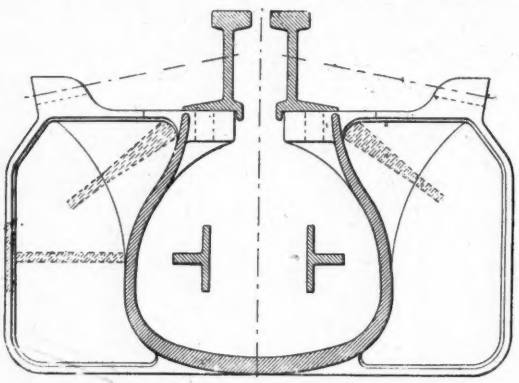

Fig. 3.—For Conduit where depth is restricted, Pont de l'Alma, Paris.

clearance should be from 9 to 10 in. to allow considerable room for water and dirt accumulation, which might otherwise endanger the operation of the road; but for relatively short distances the clearance can be reduced to 4 in., where the conduit must be reduced in height from any cause. The author has used this distance in a number of instances, and knows from experience that it is practically acceptable. Such lengths of conduit need cleaning often.

Fig. 4.—Special Shallow Conduit under Construction.

A shallow conduit was designed for use on the Pont de l'Alma, in Paris. A careful examination showed that the construction given in fig. 3 was practicable by slightly cutting the masonry arches, which was adopted. The conduit construction in this case has a total depth of about 22 in., with a 6-in. slot rail and insulators bolted to their bottom flanges. The conduit shown is in actual operation, and it can be safely recommended for special cases where the depth available is restricted. Fig. 4 is a view of this conduit during construction. One side of the cast-iron tubes is here shown specially curved to fit the centre longitudinal arch, so as to avoid excessive cutting of the masonry. Fig. 5 is a view of another special construction over the steel railway bridge of the new line from the Gare St. Lazare to the Invalides. This conduit construc-

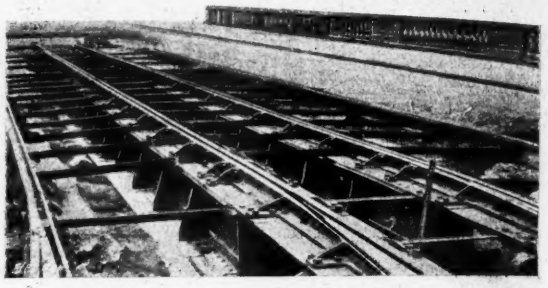

Fig. 5.—Special Construction over Steel Railway Bridge, Paris.

tion rests directly on the steel beams of the bridge, and spans from one to another of them; it therefore had to be in the form of a bridge itself, and a built-up beam construction was adopted. Where the regular yoke construction is used these project from 6 to 8 in. below the tube depth, which is normally from 24 in. to 28 in.,

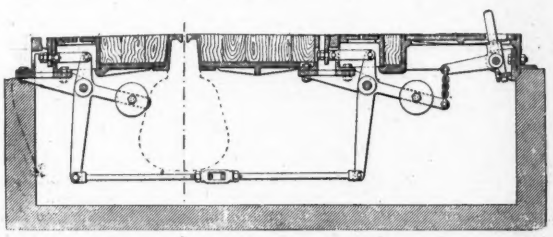

Fig. 6.—For Centre Slot. Counter Weight Mechanism for Closing Rail Switches Automatically, Paris.

depending upon the method of insulator suspension, as already explained. A careful examination of a proposed route should be made to see if the sub-surface constructions would permit the building a safe practicable conduit. With this broad question settled in the affirmative, there is no good reason why the expense and annoyance due to the removal and lowering of many sub-surface obstructions should not be avoided by taking advantage of the possibility of varying the depth required for the conduit.

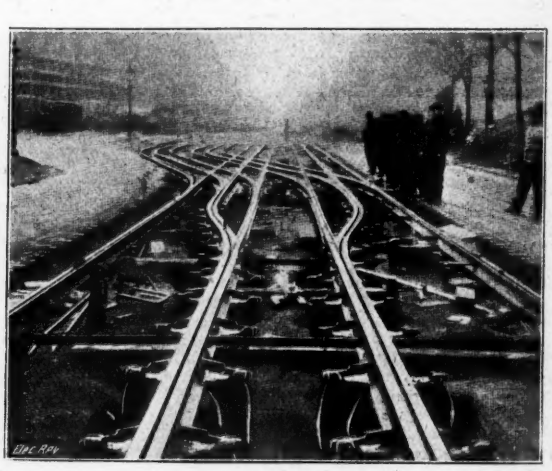

Fig. 7.—Deflection of Side-slot to Centre-slot, Paris.

It may not be amiss to say a few words about the switches, because in practice they are responsible for most of the interruptions in service. A misplaced switch has the result of guiding the car in one direction and the plough in another. The latter can become twisted in the conduit in a variety of ways, but with the too sure result of interrupting the traffic for a time, which, in the author's experience, may vary from 15 minutes to two hours. This bare statement is sufficient to demonstrate the necessity of so designing the switches as to reduce to the strictest minimum the possibility of such accidents.

There are two distinct cases to be considered. The first is where the track is alone switched, the slot being continuous. Fig. 6 is a sectional view of a counterweight mechanism which can be adjusted to close the switches automatically, so that the track should be always open for the passage of the cars using the conduit track. This precaution should always be taken, but it may fail. When this happens it is usually due to something solid having fallen into the switch, and in consequence the tongues fail to return to their normal position. In the case of the centre-slot construction, the danger of an accident can be avoided if the ploughs are hung on slides which permit their travelling completely across the car. If the ends of these slides are left free of all obstruction from the truck or otherwise, the plough will drop off when the car has reached a certain distance on the wrong track. But the motorman generally perceives his error before that occurs, and simply stops and reverses the car, with the result of no interruption worthy of mention. Even in the worst case of losing the plough the car is simply "dead," and can be pushed in by the succeeding one. A trap should be placed conveniently at each such switch, so that the plough can be taken out with no loss of time. If the accidents are only of this nature, they are not worthy of any serious attention. But in the case of the ordinary side-slot conduit, this result cannot be attained. The tongue there in one position covers the slot. In case of a false position of the switch, an accident will happen which almost surely will result in a serious interruption of the car service. To avoid this difficulty, the author suggests that before the switches are reached the slots should be deflected to the central position.

In the second case, with a slot switch, the slot tongue is a necessity. The author recommends for the side-slot conduit the same deflection of the slot to the central position. This serves the purpose of being able to avoid the side-slot slot switch, the constructional difficulties of which were enlarged upon in the first part of the paper. The danger of an accident with this switch is limited to the case where the point of the slot tongue is directly in the slot. A "head-on" collision can then take place. But if the tongue is not thrown in the same direction as the track tongues, the same slight interruption may happen as above explained, providing, of course, that the system of plough slides there mentioned is in use. Fig. 7 shows the case of a side-slot conduit deflected to the centre of the track at a slot switch. There are no mechanical or electrical difficulties in this case, the results of actual operation in Paris having demonstrated this statement. Fig. 8 is a view of a slot switch operating mechanism. With one movement of the handle the three tongues are thrown in unison. For a dense traffic it is advisable to put a switchman at such slot switch points, to reduce to a minimum the danger of accidents and of interruptions of service. The author feels confident that the accidents at switching points will be almost negligible if the construction above indicated is followed.

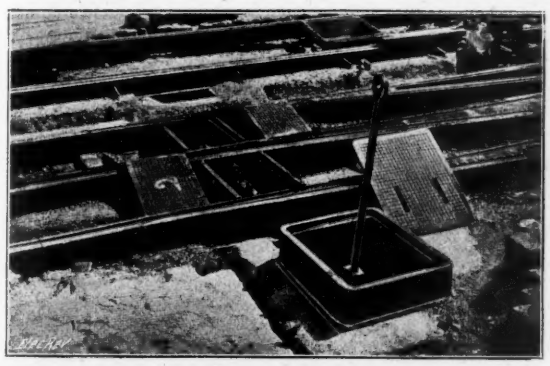

Fig. 8.—Tramway- and Conduit-Switch, Paris.

(To be concluded.)

THE ARC LAMPS AT FULHAM.

The arc lamps which were supplied to the borough of Fulham by the General Electric Company, Limited, and which received a short notice in our recent description of the electricity works, were manufactured by the firm at their Manchester works; as several improvements have been embodied in the design, a description of the lamps may be of interest.

The alternating currents are passed through Ferranti rectifiers, which supply two arc lamp circuits with rectified current. The arc lamps are arranged 44 in series—alternate lamps on each circuit—and they are carried on posts of ornamental design bearing the borough arms, at a height of about 25 ft. from the ground. Each post has, in addition, two handsome brackets for 32-c.p. incandescent lamps, and an Edmondson automatic switch of improved design in the base.

The arc lamps are of the "Angold" 12-ampere 32-hour double carbon type, each being supported on a brass ring insulated from the lamp frame by micanite, the insulation of which is tested at a pressure 50 per cent. above the maximum voltage of the Ferranti rectifier. This brass ring is also insulated from the lamp column by a rubber seating, which thus gives the lamp a double insulation from earth.

The controlling solenoids are differentially wound, and are extra powerful, so as to be practically independent of the friction of the working parts of the lamp.

The feed is controlled by racks cut on the negative slide rods, geared up to escapements and balance wheels which are not affected by tilting the lamp. The movements of the balance wheels (and consequently of the carbons) are controlled by spring catches, which exert a very slight pressure, so that a feed can be started and stopped with a minimum expenditure of energy, and consequently a small variation in the length of the arc. This arrangement will stand any amount of vibration without letting the carbons run together, and also ensures constant "feeding points." There is no periodic changing over of the arc from one pair of carbons to the other, and there are no parts that can suffer from the wear and tear of trimming. All the slide rods are so arranged that they can be bent considerably before they will stick, and the amount of rod exposed to the atmosphere and the gases in the globe is reduced to a minimum, being on the average only 6 in. for each slide. No flexible wires are exposed, and consequently no "shortings" and fusing by contact with other parts can take place. There is no insulating material used within 12 in. of the arc, and the rack rods never come outside the mechanism chamber, so that they cannot collect dust.

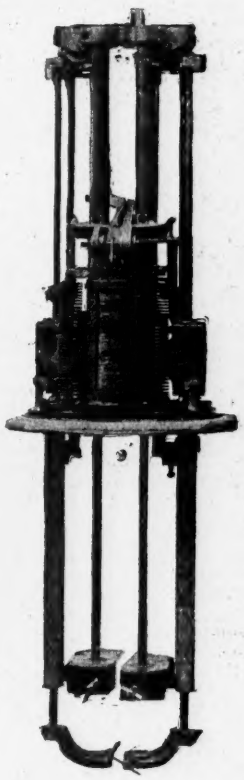

Fig. 1.

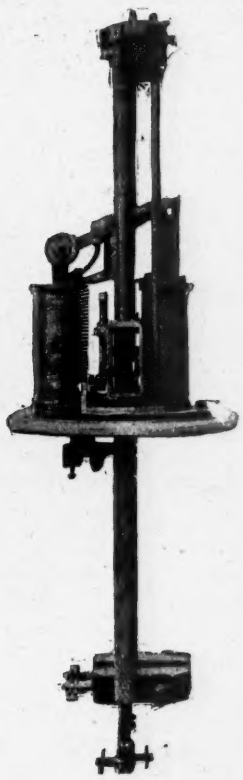

Fig. 2.

The movement of the lever, which is operated by the two plunger cores, is normally very small, owing to the good regulation of the lamp mechanism. Should, however, the voltage get too high, owing to the lamp failing to act, or the carbons being both burnt out, the shunt coil pulls its core right down, and the current is shunted by a special contact through a small resistance and a third terminal, thus releasing the automatic switch, and putting on the two incandescent lamps which are on the private lighting mains. This cut-out arrangement cannot be opened if the carbons are burnt out, or if no carbons are in the lamp. It comes into operation when the lamp is only 5 or 6 volts above normal pressure, consequently none of the insulation used in the lamp is subjected to more than 50 volts pressure. An important improvement is also the fact that the weight of the holder of the first burnt-out carbon is always on the mechanism; there is, therefore, no alteration of voltage when the second carbon comes on. In fact, the weight on the mechanism is always constant.

The interior mechanism of the lamp is illustrated by figs. 1 and 2, taken at right angles to each other. These show the racks and movements, as well as the general construction of the lamps.

THE RATING OF ELECTRIC LIGHT AND POWER STATIONS.

In attempting to set forth the law relating to the rating of electric light undertakings to the relief of the poor, one is confronted with the primary difficulty that the subject, so far as its discussion in the law courts is concerned, is a new one. The principles of rating, however, remain the same, and it is one argument in favour of our present law of rating that no matter how novel or ill-adapted a new industry may be, its profits can still be attached, albeit in a cumbersome manner for the relief of the poor.

General Principles of Rating.—It is provided by the Parochial Assessments Act, 1836, Sec. 1 (6 and 7 Will. 4, c. 96) as follows:—"No rate for the relief of the poor in England and Wales shall be allowed by any justices, or be of any force which shall not be made upon an estimate of the *net annual value* of the several hereditaments rated thereunto; that is to say, of *the rent at which the same might reasonably be expected to let from year to year*, free of all usual tenant's rates and taxes, and tithe commutation rent charge, if any, and deducting therefrom the probable average annual cost of the repairs, insurance and other expenses, if any, necessary to maintain them in a state to command such rent. Provided always that nothing herein contained shall be construed to alter or affect the principles or different relative liabilities (if any) according to which different kinds of hereditaments are now by law ratable."

The above section was repealed so far as the metropolis is concerned by the Valuation (Metropolis) Act, 1869 (32 and 33 Vict., c. 57). Under that Act (Sec. 4) the "ratable value" of property in the metropolis means the gross value after deducting therefrom the probable annual average cost of the repairs, insurance and other expenses. The "gross value" (also defined by Sec. 4) means "the annual rent which a tenant might reasonably be expected, taking one year with another, to pay for an hereditament, if the tenant undertook to pay all usual tenant's rates and taxes, and tithe commutation rent charge, if any, and if the landlord undertook to bear the cost of the repairs and insurance, and the other expenses, if any necessary to maintain the hereditament in a state to command the rent."

In applying the above principles of rating to electric light and power installations, many difficulties present themselves. To begin with, the absence of judicial decisions relating to the application of these rules to the supply of electricity renders it necessary to assume that the principles which have been applied to the rating of gas and water works also apply to electric lighting works. Anything hereinafter stated as to the law of rating for electricity supply works must be taken with the qualification that it has not yet been judicially decided that electricity is for this purpose exactly similar to gas or water. Seeing that the legislation has provided statutory rules and regulations for the supply of *electricity* by the simple expedient of incorporating many important sections of the *Gas* Works (Clauses) Acts with the Electric Lighting Act, 1882, the presumption that electricity is equivalent to gas for the purposes of the law of rating is, to say the least, based upon solid ground. [*Vide* Sec. 12 of the Electric Lighting Act, 1882 (45 and 46 Vict., c. 56), which incorporates Sub-secs. 6—12, 18—20 of the Gas Works Clauses Act, 1847 (10 and 11 V., c. 15); and Sub-secs. 38—42, 45, and 46 of the Gas Works Clauses Act, 1871 (34 and 35 V., c. 41)]. Lastly, when the Canterbury Electric Light Works were assessed (on appeal) by the Recorder of that town, he practically adopted the rules already applied to gas.

What is "Occupation of Land"?

The first important question which arises is—Does the exercise of a right to lay down mains, and transmit electricity through them, constitute an occupation of land within the meaning of the sections to which allusion has been made? Without going into the older authorities at any length, it may be stated that the law now answers this question in the affirmative. In R. *v.* Chelsea Waterworks Company [(1833) 5 B. and Ad. 156] it was argued that inasmuch as the surface of the land above water pipes of the company was in the occupation of other persons, the space occupied by the pipes could not also be rated. The Court, however, held that this made no difference. Only one case need be referred to to set this point at rest. In 1859 an attempt was made by the West Middlesex Water Company to escape paying rates in respect of a conduit beneath a highway which was used for conveying water from a pumping station to the reservoir. It was contended on behalf of the company that they were not in ratable occupation of the land. Wightman, J., delivering the judgment of the Court, said: "The first question is, whether the company is ratable for their mains which are laid under the surface of the highway, without any freehold or leasehold interest in the soil thereof being vested in the company? We think they are. These mains are fixed capital, vested in land. The company is in possession of the mains buried in the soil, and so is, *de facto*, in possession of that space in the soil which the mains fill for a purpose beneficial to itself. The decisions are uniform in holding gas companies to be ratable in respect of their mains, although the occupation of such mains may be *de facto* merely, and without any legal or equitable estate in the land where the mains lie by force of some statute." [R. *v.* West Middlesex Waterworks (1859), 1 E. & E., 716].

Who are Occupiers?—While it is clear that electric mains, &c., "occupy" land, the question who are the occupiers is not always so easy to determine. Such a question must be decided by looking at all the facts of a case. Thus in the Southport case a local board had the exclusive right of laying gas mains and pipes within a township, but they were bound under a private Act to supply gas through such pipes to the Corporation of Southport for the lighting of the town. It was decided that the local board who had power to lay down and alter the pipes and mains were occupiers for rating purposes. [Mayor, &c., of Southport *v.* Ormskirk Union (1893) 2 Q.B., 468; (1894) 1 Q B., 196.]

Mr. Justice Cave said: "The local board are the owners of these gas mains, and they have granted, or rather the Act of Parliament for them has granted, to the Corporation of Southport the use of the same not generally, but simply for the purpose of the supply of gas, so that all that is taken out of the local board is the use of the mains for the particular purpose, the supply of gas and nothing else, and all other rights remain in the local board."

It is not difficult to imagine a case in connection with the supply of electricity which would give rise to a discussion precisely similar to that which took place in the Southport case. The undertakers are nearly always bound by their provisional order (which now incorporates the schedule to the Electric Lighting Act, 1899) to supply energy to the local authority for the purposes of lighting the streets. It seems clear from the above case that in such circumstances the local authority would not be occupiers for the purposes of rating.

The Theory of Hypothetical Rent.—The application of the principle that the ratable value must depend upon the rent at which an undertaking would be expected to let from year to year is naturally attended with difficulty in the case of an electric light undertaking. The assessment committee have to consider what the hypothetical tenant of an entire system would pay by way of rent—without having any other guide than somewhat empirical assumptions based upon a variety of considerations. It is hardly necessary to observe that an *actual* tenant of such an undertaking is unknown.

The following questions, which are hereafter dealt with in order, appear to arise when an endeavour to estimate hypothetical rent is made:—(1) In valuing the works, wires, &c., of an electric lighting company, are the profits earned by the company to be taken into account? (2) What is the proper principle of valuing an electric lighting undertaking as a whole when occupied by a trading company, and upon what principle is the value of the whole undertaking to be apportioned among the several parishes into which the undertaking extends? (3) Whether in rating electric lighting stations occupied by the local authority, or similar public bodies, when the profits earned by the occupiers are devoted to public purposes, the occupiers are ratable? (4) Whether in rating a local authority, or any other public body, the profits actually earned by the occupiers are the proper basis for calculating ratable value?

Whether Profits are to be taken into Consideration.—With reference to the question whether the profits earned by a company should be taken into account for the purpose of estimating hypothetical rent, a distinction was formerly drawn between companies which supplied a natural commodity such as water, and those which furnished a manufactured commodity such as gas. This distinction was clearly abolished by the definition of "net annual value" in the Parochial Assessments Act, 1836, and the rule may now be taken to be that the profits are always to be taken into consideration. The case of R. *v.* Sheffield United Gas Company ((1863), 32 L.J.M.C., 169) is always referred to on this point. In that case the rating authorities had ascertained the ratable value of the whole of the company's works, mains, pipes, &c., by deducting from the gross receipts the working expenses and a sum for tenants' profits, tenants' rates and taxes, and the average cost of repairs, renewals, and insurance of buildings, stations, plant, and mains, the remainder being put as the ratable value of the whole undertaking. This was clearly an assessment based upon profits. It was argued on behalf of the company that the land occupied by them should be valued according to rents given for other lands in Sheffield and used without buildings, and as to the mains and pipes under the streets that they should be valued by a similar method, "*only* allowing an increased rental for the consideration that the company must necessarily obtain the particular locality, and might therefore be forced by the owner of the land to pay an increased rent *for it*." This argument was rejected by the Court, who adopted the valuation made by the Assessment Committee upon the basis of profits, apparently for the reason that in estimating the increased rent the landlord and tenant would both have regard to the net profits which the occupier of the mains would be able to earn.

What Profits are to be Considered.—In estimating the ratable value, the Assessment Committee, as we have already seen, are bound to consider "the annual profit." It is not always easy to decide what should be regarded as profit for this purpose. Thus, while a certain proportion of the company's earnings go towards a dividend for the shareholders, it is not unusual to set aside the remainder as a reserve fund to be drawn upon in times of stress. The point whether the reserve fund should be looked at was considered, but not decided in the case of Gas, Light, and Coke Company *v.* City of London Union. [Ryde's "Rat. App." (91—93), 204.] The better opinion would seem to be that the reserve fund should *not* be taken into consideration, for it is but a capital fund which adds to the solidity and rent-earning capacity of the whole undertaking.

What Year's Profits are to be taken into Consideration.—The solution of this question depends very much upon whether the property in question is within or outside the metropolis. A valuation list within the metropolis is only revised every five years (The Valuation (Metropolis) Act, 1869, 32 and 33 V., c. 67, Sub-secs. 44, 45, 46); and an appeal against a valuation in the Metropolis must be lodged before the valuation list comes into force.

The "Metropolis" for the purposes of the Act includes every union and every parish not in union, which for the time being are either wholly, or for the greater part in value thereof, respectively situate within the jurisdiction of the Metropolitan Board of Works,

appointed under the Metropolis Management Act, 1855 (18 and 19 Vict., c. 120). The list for the Metropolis, as altered on appeal, becomes exclusive evidence of value for five years, subject to alteration in certain cases by means of supplemental or provisional lists. Outside the Metropolis, a fresh valuation may be made each year, and with regard to the making of such a rate, it was laid down in the case of R. *v.* London, Brighton, and South Coast Railway Company, [(1851), 15, Q.B. 313], that the sessions ought to avail themselves of every light that can be afforded them down to the latest period antecedent to the actual making of the rate, in order to bring it to the greatest possible accuracy. The overseers in making a prospective rate, are to make it on the supposed prospective value ascertained by them, as well as they can from the latest evidence in their power as to antecedent value. It would seem from this that the sessions are bound to take cognizance of the last published account before the making of the rate appealed against.

The importance of making the assessment from an up-to-date account is intensified in the metropolis where the same rate generally remains in force for a full period of five years. Thus, supposing the profits of an electric lighting company in the metropolis were to suddenly fall off at or immediately before the time of making the list for the metropolis, it would obviously be just to allow that falling off to be taken into consideration, by permitting the assessment to be based upon an account drawn up in respect of the year immediately preceding the making of the list.

(*To be continued.*)

THE BOARD OF TRADE INQUIRY re ELECTRICAL PRESSURE.

(*Continued from page* 446.)

Sir Courtenay Boyle continued the hearing of the inquiry for an alteration of proviso to No. 13 (6) of the regulations made by the Board of Trade, ensuring a proper and sufficient supply of electricity, on Thursday, at the Westminster Town Hall. Mr. Balfour Browne, K.C., Mr. R. W. Wallace, K.C., and Mr. M. D. Warmington appeared for the Westminster Electric Supply Corporation, Limited; Mr. Littler, K.C., and Mr. Craies for the Hotel Windsor and the Junior Constitutional Club; Mr. J. Roskill for the City of London Electric Lighting Company; Mr. R. Cunningham Glen for the Borough of Paddington: the Hon. A. Lyttleton and Mr. G. J. Talbot for the London County Council; Mr. Danckwerts, K.C., and Mr. A. J. Walter for the Corporation of London; Mr. E. Moon for the Chelsea Electric Lighting Company and the Metropolitan Electric Supply Company.

At the sitting of the inquiry on the previous Tuesday, Sir Courtenay Boyle had submitted to counsel for their consideration the following clause:—"Provided that no change shall be made in the pressure of the supply to any premises which were supplied with energy by the undertakers, except with the consent of the consumer, but where the consumer withholds his consent after the undertakers have offered to pay the reasonable cost of, or incidental to, the change, the undertakers may appeal to the Board of Trade, and the Board may, if they think fit, dispense with the consent of the consumer on such conditions as the Board impose."

Mr. Littler, K.C., said he had no amendment to offer to the clause, but his position was simply this:—All they wanted was that, as a condition of their consent, they should, both as regarded the past and the future, be put in exactly the same position as if a change had not been made. They did not require any blackmailing price.

Sir Courtenay Boyle: Who is to determine whether you are put into the same position?

Mr. Littler said they did not say they (his clients) should themselves determine. What his clients said was that they had a right vouchsafed to them by the Board of Trade, but they would not stand absolutely on that right, provided they could be perfectly assured they would be recouped against any reasonable expenses, and guarded against expense in the future.

The Hon. A. Lyttleton said the clause he had to present agreed pretty well with the City Corporation, and he thought would carry out what had been stated by Mr. Littler. Prof. Kennedy had admitted that the consumer should be indemnified. The advantage of the proposal was highly controversial as to the lamps, increased efficiency, and increased cost. Those were matters of absolutely genuine and *bonâ fide* controversy. The position was that for the benefit of themselves and the electrical industry the electric companies proposed a change, and they agreed that the change should cause no loss of any kind to the consumer. The consumer said he would lose largely. That was the point of the controversy, and no one could settle that who did not hear all the evidence and decide upon each case. The electric lighting companies sought to impose on the consumer the onus of the controversy—a controversy on which electric lighting authorities of great standing differed; but as this controversy was for the benefit of the electric industry it ought to be settled at the expense of the industry, provided only that this were not put to vexatious or unreasonable expense. Those were principles which he submitted were incontrovertible. By the clause he submitted they first proposed to take the dispute to the Board of Trade at the request of both parties and let the Board of Trade mediate between them, and they had little doubt that in 19 cases out of 20 the friendly suggestion of the Board of Trade would prevent any litigation whatever. If that result was not achieved, then they asked that the Board of Trade should submit the matter to an arbitrator, and that the arbitrator should thereupon settle the terms on which the change was to be made. The clause proposed by the London County Council was as follows:—"Provided that no change shall be made in the pressure of the supply to any premises which on . of were supplied with energy by the undertakers except with the consent of the consumer, but where the consumer withholds his consent after the undertakers have offered to pay the costs of the damage caused by or incidental to the change, the undertakers may appeal to the Board of Trade, and the Board of Trade may, at the request of both parties, finally settle the matter in difference between them, and failing such request, may dispense with the consent of the consumer on the following conditions, that is to say, the Board of Trade shall, in such case, refer to a single arbitrator, to be agreed upon between the parties, or, failing agreement, appointed by the Board of Trade, the settlement and due execution of such terms as shall recoup to the consumer all reasonable costs, charges, expenses, and loss incurred in consequence of the change, and shall place the consumer in at least as beneficial a position as if the change had not been made. The costs of both parties to the arbitration, to be settled, in case of difference, by the arbitrator, shall be paid by the undertakers, provided always that if the arbitrator certifies that the consumer has vexatiously withheld his consent, the consumer shall bear his own costs of the said arbitration. Provided always that anything done hereunder shall be without prejudice to the conditions imposed by the London County Council or the local authority in regard to the alteration of the standard pressure."

Mr. A. J. Walter said the clause proposed by the City Corporation was in substance the same as that brought up by the County Council. It was:—"Provided that no change shall be made in the pressure of the supply to any premises which on were supplied with energy by the undertakers, except with the consent of the consumer; but where the consumer withholds his consent after the undertakers have offered to pay the costs of and damage (including a reduction in the price of supply of energy) caused by, or incidental to, the change, the undertakers may appeal to the Board of Trade, and that Board may, if the parties agree, finally settle the matters in difference between them, and failing such agreement, may dispense with the consent of the consumer on the following conditions, that is to say:—The Board of Trade shall, in such case, refer to the arbitration of a single arbitrator, to be agreed upon between the parties, or failing such agreement, appointed by the Board of Trade, the question of the conditions under which the change shall be allowed, and the due fulfilment of the same by the undertakers, such agreements shall include those imposed by the London County Council or the local authority, as the case may be, under these regulations. The reasonable costs of both parties to the said arbitration shall be paid by the undertakers."

Mr. Roskill said he must strongly oppose the contention that the change was solely for the benefit of the undertakers, and he believed the undertakers had cause to complain of the way in which they were treated. For the development of electric enterprise, it was imperative that this change should be made. No evidence had been given as to the number of persons who would oppose the change. There had been 1,602 consumers applied to in the City of London, and only 22 had refused. The suggestion in the clause of the County Council, and more especially in the clause of the City Corporation, was a direct invitation to the consumers to resist that which, in the opinion of experts, was a necessary change.

Mr. Warmington, on behalf of the Westminster Electric Supply Company, addressed Sir Courtenay Boyle on the same lines as Mr. Roskill.

Mr. Glen said that as the only aim of the Paddington Council was to protect the consumer, he could support either of the two suggested clauses.

Mr. Moon contended that the claim for an indemnity was made under a misapprehension as to the regulation of 1896. His learned friends had talked as if the regulation of 1896 had given an indefeasible right to a consumer taking a supply at that date to refuse to consent to any alteration of the supply. In 1896 it was clear that there was an idea that it might be advisable to increase the pressure. At that time there was no 200-volt lamp which was efficient, and therefore there was no satisfactory lamp in the market that could be used with 200 volts pressure. Under these circumstances the Board of Trade naturally said they would not commit themselves or allow an experiment to be made without the consent of the consumer. The state of things which existed in 1896 had passed away, and they asked that the temporary estoppel created by the Board of Trade might be removed in favour of the development of the enterprise, and in order to prevent useless expenditure of capital. He submitted that the regulation of 1896 was merely in the nature of a temporary estoppel, and was not a permanent decree, and that the claim for indemnity rested on no good foundation. They asked to be put back into the position in which they were in 1896, when they might have applied to the Board of Trade for their consent to an alteration of the pressure. What they were discussing was what was best for the whole of the consumers, and not for particular consumers. It was not true to say there would be no advantage to the 100-volt consumer for the change.

Mr. Littler pointed out that he had not presented his evidence that there would be no advantage.

Sir Courtenay Boyle said he hoped counsel would not go into it, as so far he had only heard one side.

Mr. Moon said the effect of the clauses proposed that day would be to invite everybody to say they would not consent and threaten to go to arbitration, and they would come to the companies and say, "It will cost you a great deal if you go to arbitration, and you will have to pay in any event; had you not better give us some-

thing extra to avoid arbitration?" He would, however, point out that a fair clause would in the end be better for the consumer than an unfair clause, because they might as a last resort have to raise the price.

Mr. Lyttleton argued that Mr. Moon's argument was founded on the most extreme views. His evidence had not yet been heard, but he founded his arguments on the evidence of Prof. Kennedy.

Sir Courtenay Boyle expressed the hope that counsel would not comment at that point on evidence which had been given.

Mr. Moon: I renounce Mr. Kennedy and all his evidence. I am not bound by his evidence.

Mr. Lyttleton said he relied on the evidence of a distinguished opponent. The question was asked Prof. Kennedy whether he agreed that the consumer should be paid the whole of the expense he was put to, and the witness replied "Yes." Then he was asked by Sir Courtenay Boyle what advantage the consumer would get by having 200 volts instead of 100 volts, and his answer was, "I do not think he gets any benefit; I do not think he knows the difference." On such evidence as that of their opponents, he contended it was a case for indemnity.

Mr. Wallace, K.C., said the clause proposed by the Board of Trade would meet all the circumstances of the case.

Sir Courtenay Boyle said the thing had been so well argued that he would be able to place evidence before the Board of Trade which would enable them to draft a clause. That was if the counsel agreed to this.

Mr. Lyttleton said that would depend on whether Sir Courtenay was able to say to the Board of Trade that he was satisfied that there was a genuine controversy as to what the benefits would be.

Sir Courtenay Boyle said as far as he himself was concerned, he was prepared to admit that there was matter for controversy, but he must leave it to counsel as to whether they wished to call evidence. He could not say that he was prepared to report in favour of taking either clause verbatim. The question was whether the objectors were satisfied to leave the matter in the hands of the Board of Trade. He did not think it would help him to hear evidence, but that was for counsel to decide.

After consultation, Mr. Walter asked whether Sir Courtenay Boyle could submit a fresh clause for the consideration of counsel.

Sir Courtenay Boyle said he could not consent to that. They must be content to leave the matter in the hands of the Board of Trade.

After an adjournment to enable further consultation to take place,

Mr. Lyttleton said the objectors felt compelled to call evidence.

Mr. Gunning, in charge of the electric lighting department of the London County Council, was called, and said he was of opinion that the change would be of no benefit to the consumer, and in many cases would bring a loss.

Mr. Eck, consulting engineer, and Prof. Ayrton gave evidence to a similar effect.

The inquiry was adjourned.

Sir Courtenay Boyle sat again on Monday at the Westminster Town Hall.

At the commencement Mr. Littler, K.C., complained that the Westminster Corporation would not allow a witness he wished to call, who was in their service, to appear.

Mr. Lyttleton, summing up his case, said it was recognised that this change was one the Board of Trade was prepared to authorise, and the simple question was on what terms it should be authorised. The first argument put forward by the companies, he thought, had been greatly modified. That argument was to this effect: "Here is a change for the benefit of the industry, the companies, and the consumer, and a very few of the consumers have used the advantage of their position to stand out as dogs in the manger and endeavour to extract terms which they are not entitled to." That manifestly was not a correct statement. No one could deny that there was a substantial case from the view of the consumers who stood out, and he submitted the true statement of the case was this: "Although it is perfectly true that the great majority of the consumers in Westminster, captivated by statements of a sanguine character made by the companies, acceded to the change being made, yet a few consumers less credulous held out, and their position now is that after elaborate inquiry they have satisfied themselves that the change will not result as the sanguine estimates of the promoters have endeavoured to make them believe, and it is exceedingly questionable whether the change should be made at all, and certainly, if it should be made, it should be done at the expense of the companies." Mr. Moon had contended that the Board of Trade clause of 1896 was merely in the nature of a temporary estoppel, but he (Mr. Lyttleton) submitted this argument was fallacious, inasmuch as the premises on which it was based were not borne out by the facts. Accepting the rule that the Board of Trade had the power to alter its own regulations, yet he submitted that the state of things was now substantially the same as in 1896. Mr. Moon said that in 1896 higher voltage lamps were in an experimental stage, and that the experimental stage was passed now; but this statement he absolutely traversed. He thought that the evidence called by the London County Council had proved that the experimental stage had not ceased. If they took the Westminster case alone they had heard from Mr. Drake that he had been inundated by complaints from consumers who had accepted the change, and it had been shown that the 200-volt lamp was less efficient, and cost the consumer more, than the 100-volt lamp. If the consent of the consumer was to be dispensed with, it meant that the companies would have a dispensation of the law of trespass. Sir Courtenay Boyle himself had admitted that there was an acute controversy on the subject, and that being so, it was only right that the consumer should, in such an unequal contest, be able to go before an arbitrator, and provided he did not act unreasonably, should be able to do so without expense to himself.

Major Cardew was then called by Mr. Littler, and expressed the opinion that the consumer would not obtain any advantage by the change, and he should be protected as suggested by the clause of the London County Council. All the indoor fittings and wires would have to be thoroughly overhauled, and in many cases replaced, and this would naturally cause damage to decorations, and much inconvenience. He did not think it was possible in the smaller sizes that the 200-volt lamps could last as long, or keep up so good a light.

Mr. Roskill: Do you represent to the Board of Trade that it is not desirable to change the voltage?—It is a question of doing away with the clause.

Then I understand you do not represent that the change is undesirable? I think it would not be a judicious policy that the Board of Trade should absolutely veto the use of 200 volts.

By Mr. Littler: As made at present, the 200-volt lamp was not so satisfactory as the 100-volt lamp.

Mr. A. Rose, London manufacturer to the amalgamated concerns of Rose & Bird and the Crystal Lamp Company, considered that the 200-volt lamp was not so efficient as the 100-volt lamp. If, in the future, an improvement was made to the 200-volt lamp, it would equally apply to the 100-volt lamp.

By Mr. Balfour Browne: They made large quantities of 200-volt lamps as well as 100-volt lamps.

Mr. V. D. B. Cooper, electrical engineer, concurred with the evidence given by Major Cardew. He was adviser to the Hotel Windsor, and he asked contractors to give an estimate of the cost of refitting that hotel for the 200-volt lamps. The estimate was £966, and this did not include cost of redecoration. For the Junior Constitutional Club the cost would be £530.

By Mr. Balfour Browne: Provided they lost nothing by the change taking place, they would not object to it.

Mr. Littler addressing Sir Courtenay Boyle on behalf of the Hotel Windsor and the Junior Constitutional Club said they had come to the company and took their supply on the faith of the clause of 1896, and if their consent was to be obtained it should be only on the undertaking that they should be placed in all respects the same as before any change was made. He again complained of the action of the Westminster Corporation in refusing to allow a witness to appear, and expressed the hope that when the Board of Trade went before Parliament they would get a clause to compel the attendance of any witness.

Sir C. Boyle: I do not think they will.

Mr. Littler proceeded to read a great mass of correspondence between the Hotel Windsor and the Westminster Electric Supply Corporation, and he contended that the company had treated the hotel company very badly.

Mr. Balfour Browne, replying for the Westminster Electric Supply Company, contended that the change was in the interests of the public at large. The company was not an enemy to the consumer but a partner. He admitted that the company would get a benefit from the change as they would not have to raise so much capital, and if capital was not raised that was for the benefit of the consumer. He asked that the clause suggested by Sir Courtenay Boyle should be accepted, subject only to the insertion of a time limit.

The inquiry was adjourned till to-day.

THE NAVAL BOILER COMMITTEE'S INTERIM REPORT.

This interim report, referred to in our leading article, reads as follows:—

1. The Committee are of opinion that the advantages of water-tube boilers for naval purposes are so great, chiefly from the military point of view, that, provided a satisfactory type of water-tube boiler be adopted, it would be more suitable for use in his Majesty's Navy than the cylindrical type of boiler.

2. The Committee do not consider that the Belleville boiler has any such advantage over other types of water-tube boilers as to lead them to recommend it as the best adapted to the requirements of his Majesty's Navy.

3. The Committee recommend:—(*a*) As regards ships which are to be ordered in the future:—That Belleville boilers be not fitted in any case. (*b*) As regards ships recently ordered, for which the work done on the boilers is not too far advanced:—That Belleville boilers be not fitted. (*c*) As regards ships under construction, for which the work is so far advanced that any alteration of type of boiler would delay the completion of the ships:—That Belleville boilers be retained. (*d*) As regards completed ships:—That Belleville boilers be retained as fitted.

4. In addition to the Belleville type of boiler, the Committee have had under consideration four types of large straight tube boilers which have been tried in war vessels, and are now being adopted on an extended scale in foreign navies. These are:—(*a*) The Babcock and Wilcox boiler; (*b*) the Niclausse boiler; (*c*) the Dürr boiler; (*d*) the Yarrow large tube boiler. (*a*) and (*b*) have also been tried in our own Navy with satisfactory results, and are now being adopted on a limited scale. If a type of water-tube boiler has to be decided on at once for use in the Navy, the Committee suggest that some or all of these types be taken.

5. The Committee recommend that the completion of the two

sloops and the second-class cruiser fitting with Babcock and Wilcox boilers, and the sloop and first-class cruiser fitting with Niclausse boilers, be expedited, in order that the value of these types of boilers for naval purposes may be ascertained at the earliest possible date. This is especially important, as the Babcock and Wilcox boiler adopted in the ships under construction differs materially from the Babcock and Wilcox boiler as fitted in the *Sheldrake*.

6. The Committee recommend that boilers of the Dürr and of a modified Yarrow type be made and tested at the earliest possible date, under their supervision, with a view of aiding the selection of one or more types of water-tube boilers for use in his Majesty's ships. For this purpose the Committee suggest that two cruisers, not smaller than *Medea* class, with vertical triple-expansion engines, be placed at their disposal, and that they be empowered to order at once Dürr and Yarrow boilers to be fitted to them, and to order also the removal of their present boilers and the necessary modifications of their machinery, so that the performance of the types of boilers named may be definitely ascertained under ordinary working conditions from extended seagoing trials. The Committee suggest vessels not smaller than the *Medea* class, because the evidence before them shows that it has been difficult to draw from torpedo gunboat trials conclusions fully applicable to larger vessels.

7. With reference to paragraph (1) evidence has been given before the Committee to the effect that three most important requirements from the military point of view are:—(*a*) Rapidity of raising steam and of increasing the number of boilers at work. (*b*) Reduction to a minimum of danger to the ship from damage to boilers from shot or shell. (*c*) Possibility of removing damaged boilers and replacing them by new boilers in a very short time and without opening up the decks or removing fixtures of the hull. These requirements are met by the water-tube boiler in a greater degree than by the cylindrical boiler, and are considered by the Committee of such importance as to outweigh the advantages of the latter type in economy of fuel and cost of up-keep.

8. The opinion expressed by the Committee in paragraph (2) has been formed after a personal examination of the boilers in a number of his Majesty's ships, including the *Diadem, Niobe, Europa, Hermes, Powerful, Furious*, and *Ariadne;* upon the statements of defects which have been placed before them; and the evidence of the chief engineers of those vessels and other officers on the engineering staff of the Admiralty and Dockyards. This evidence is being printed, and will be forwarded when ready.

9. The Committee consider the following points in relation to the construction and working of the Belleville boiler to constitute practical objections of a serious nature:—(*a*) The circulation of water is defective and uncertain, because of the resistance offered by the great length of tube between the feed and steam collectors, the friction of the junction boxes, and the small holes in the nipples between the feed collector and the generator tubes, which also are liable to be obstructed, and may thus become a source of danger. (*b*) The necessity of an automatic feeding apparatus of a delicate and complicated kind. (*c*) The great excess of the pressure required in the feed pipes and pumps over the boiler pressure. (*d*) The considerable necessary excess of boiler pressure over the working pressure at the engines. (*e*) The water gauges not indicating with certainty the amount of water in the boiler. This has led to serious accidents. (*f*) The quantity of water which the boiler contains at different rates of combustion varying, although the same level may be shown on the water gauges. (*g*) The necessity of providing separators with automatic blow-out valves on the main steam pipes to provide for water thrown out of the boilers when speed is suddenly increased. (*h*) The constant trouble and loss of water resulting from the nickel sleeve joints connecting the elements to the feed collectors. (*i*) The liability of the upper generator tubes to fail by pitting or corrosion, and, in economiser boilers, the still greater liability of the economiser tubes to fail from the same cause. Further:—(*k*) The up-keep of the Belleville boiler has so far proved to be more costly than that of cylindrical boilers; in the opinion of the Committee this excess is likely to increase materially with the age of the boilers. (*l*) The additional evaporating plant required with the Belleville boilers, and their greater coal consumption on ordinary service as compared with cylindrical boilers, has hitherto nullified to a great extent the saving of weight effected by their adoption, and, in considering the radius of action, it is doubtful whether any real advantage has been gained. The Committee are not prepared without further experience to say to what extent this may not apply to other types of water-tube boilers.

10. At the time the Belleville boiler was introduced into the Navy in the *Powerful* and *Terrible*, it was the only large tube type of water-tube boiler which had been tried at sea on a considerable scale under ordinary working conditions. The Committee therefore considered that there was justification for then regarding it as the most suitable type of water-tube boiler for the Navy.

11. To obtain satisfactory results in the working of the Belleville boiler, in face of the defects named in paragraph 9, more than ordinary experience and skill are required on the part of the engine-room staff. It appears, however, from the evidence placed before the Committee, that the engineer officers in charge of Belleville boilers have not been made acquainted with the best method of working the boilers, and that which experience has shown to be most effectual in preventing the pitting and corrosion of tubes.

12. In view of the rapid deterioration of economiser tubes in several vessels, the Committee have specially considered whether the extra power per ton of boiler at high rates of combustion, obtained by the use of economisers, has not been too dearly purchased. The evidence before them indicates that at the lower and more usual rates of combustion the *Powerful* type of boiler has given results as satisfactory as the economiser type. It is at the same time less complex, and free from the special risks of tube deterioration which have proved so serious in many cases, notably in the *Europa*. They therefore recommend, for ships under construction, that the non-economiser type should be reverted to where practicable, with the tubes raised higher above the fire-bars to increase the combustion space, and that where possible the steam collectors should be made larger, and more accessible internally.

13. The evidence before the Committee shows that a large proportion of the coal expended in the Navy is used for distilling and other auxiliary purposes, in harbour as well as at sea. For such purposes, the cylindrical boiler is, in the opinion of the Committee, more suitable and economical than any type of water-tube boiler. They recognise that there are objections to fitting cylindrical and water-tube boilers in combination, but they believe that those drawbacks would be more than compensated for by resulting advantages, observing that the cylindrical boilers could be used for supplying distilled water in case of failure or insufficiency of the evaporating plant. On these grounds, it is considered desirable that all new vessels of large power should be provided with cylindrical boilers to do the auxiliary work.

14. The Committee have to state, for the information of their Lordships, that a series of comparative trials for determining economy in coal and water consumption were arranged in October, 1900, for his Majesty's ships *Minerva* and *Hyacinth*. The trials of the former ship commenced on January 7th, as soon as she was ready, but were temporarily interrupted by recent events. The Committee are, however, now informed that the *Minerva* will not be again available until after March 2nd, and that the *Hyacinth* will not be ready to commence her trials until the first week in April. It is proposed to include in these trials a full-speed run for both ships from Portsmouth to Gibraltar and back.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

4,530. "Improvements relating to the jointing or terminating of electric cables or combinations of multiple-core cables." R. Appleyard and J. F. Cootе. March 4th.

4,532. "Improved safety device for overhead electric wires." A. W. Gilbody and D. Robertson. March 4th.

4,533. "Improvements in trolley wires and other overhead electric wires." A. W. Gilbody and D. Robertson. March 4th.

4,540. "Improvements relating to the covering or casing of the electric wires or leads employed in house lighting and for other purposes." F. L. Broughton. March 4th.

4,549. "An improved incandescent electric lamp." A. L. Reinmann. March 4th.

4,575. "Improvements relating to electric power distribution." H. H. Lake. (Compagnie de l'Industrie Electrique, Switzerland.) March 4th.

4,576. "Improvements in electric furnaces." R. C. Contardo. March 4th.

4,586. "Improvements in primary batteries." C. N. Gauzentes. March 4th.

4,591. "Improvements relating to the preparation and treatment of filaments for incandescent electric lamps." H. E. Newton. (C. Garner, United States.) March 4th.

4,597. "Improvements in electric demand indicators." A. Wright and The Reason Manufacturing Company, Limited. March 4th.

4,631. "Improvements in electric stop motions of drawing frames." T. Chadwick. March 5th.

4,642. "An improved underground or conduit system for the transmission of electromotive force for traction purposes." R. R. Harrison. March 5th.

4,675. "Improvements in cords for switchboards, telephones, and other electrical instruments." The London Electric Wire Company, Limited, and B. Hawke. March 5th.

4,695. "Improvements relating to the regulation of dynamos." F. Strickland. March 5th. (Complete.)

4,700. "Improvements in or relating to trolleys and like current collectors for electric railways and tramways." F. W. Leeves. March 5th.

4,709. "Sound and fireproof walls for use in connection with telephone apparatus." H. Schaffer. March 5th. (Complete.)

4,714. "Improvements in electro-magnetic traction." M. Nietzschmann. March 5th.

4,736. "Improvements in swivelling trolley heads employed in overhead wire electric traction." E. M. Munro, H. Brecknell, and H. I. Rogers. March 6th.

4,751. "Process for insulating hollow conductors." R. Deteret. March 6th.

4,760. "Improvements in electric measuring instruments." A. Campbell. March 6th.

4,763. "Improvements in insulated electric conductors." H. Edmunds. March 6th.

4,765. "Improvements in and relating to the transmission of power in the electrical propulsion of railway, tramway and other vehicles." E. W. Whiteman. March 6th.

4,767. "An improved cable for supplying the electric current to electrically-driven ploughs and for like purposes." C. Meissner. March 6th. (Complete.)

4,768. "An improved electric bell circuit for mechanically-driven ploughs." C. Meissner. March 6th. (Complete.)

4,776. "Combined engine and air compressing means for electric railway systems." R. W. Barker. (Murphy Safety Third Rail Electric Company, United States.) March 6th. (Complete.)

4,777. "Improvements in switch mechanism for surface contact railways." R. W. Barker. (The Murphy Safety Third Rail Electric Company, United States.) March 6th. (Complete.)

4,791. "Improvements in induction motors." F. M. Lewis. March 6th.

4,810. "Improvements in electrolytic interrupters." F. de Marie. March 6th. (Complete.)

4,812. "Improvements in coherers for wireless telegraphy." J. R. Milne. March 6th.

4,813. "Improvements in wireless telegraphy." J. R. Milne. March 6th.

4,814. "An improved method of operating an electric chopper switch." J. G. Childs. March 6th.

4,815. "An improved method of making fuse contacts, and holders for my detachable fuse plug, patent No. 18,051, 1898." J. G. Childs. March 6th.

4,819. "A new or improved device for connecting the trolley with the trolley-wire in electrically-driven vehicles." H. J. Weintz. March 7th.

4,820. "Improvements in switching apparatus for electric circuits." W. du Bois Duddell and T. Mather. March 7th.

4,822. "Improvements in arc lamps." J. S. Scott. March 7th.

4,841. "Improvements in and relating to swivelling trolley-heads employed in the overhead wire system of electric traction." H. E. F. Breknell. March 7th.

4,863. "Improvements in combined electro-magnetic and carbon michrophone." W. E. Rossetter. March 7th.

4,868. "Improvements in electric switches." C. W. Scott. (Date applied for under Patents, &c., Act, 1883, Sec. 103, August 16th, 1900, being date of application in United States.) March 7th. (Complete.)

4,870. "Electric coupling for railway cars." C. D. Abel. (Siemens and Halske Aktien Gesellschaft, Germany.) March 7th. (Complete.)

4,892. "Improvements relating to electrical interrupters." J. M. Davidson. March 7th.

4,899. "Improvements in and relating to overhead wires and guard wires for electric traction and other purposes." H. R. Burnett. March 7th.

4,902. "Improvements in electrical cables." M. J. P. O'Gorman. March 7th.

4,928. "Improvements in fuses for distribution boxes, the same being applicable for single fuses of electric light installations." P. Mushet and D. B. Selkirk. March 8th.

4,940. "Improved coupling joint or connection for electric wires and fittings." M. Railing and G. H. Ide. March 8th.

4,967. "Improvements in electrical measuring instruments for use as power indicators and the like." K. Edgcumbe and E. I. Everett. March 8th.

4,981. "Improvements in or relating to Röntgen ray apparatus." G. Bowron. March 8th.

4,986. "Improvements in and relating to electric switches and cut-outs." F. H. Headley. March 8th.

5,007. "Improvements in the manufacture of electrical switches." A. Watson. March 9th.

5,017. "Improvements in batteries." G. Heidel. March 9th. (Complete.)

5,038. "Improvements in incandescent electric lamps." H. C. Mance and Nernst Electric Light, Limited. March 9th.

5,039. "Improvements in preparation of Nernst conductors for electric lamps." C. C. Garrard and Nernst Electric Light, Limited. March 9th.

5,040. "Improvements in Nernst incandescent electric lamps." C. C. Garrard and Nernst Electric Light, Limited. March 9th.

5,041. "Improvements in incandescent electric lamps." J. Swinburne and Nernst Electric Light, Limited. March 9th.

5,042. "Improvements in glow-bodies for Nernst incandescent electric lamps." B. M. Brake, M. Solomon, and Nernst Electric Light, Limited. March 9th.

5,043. "Improvements in rods for Nernst incandescent elect ic lamps." L. S. Powell and Nernst Electric Light, Limited. March 9th.

5,055. "Improvements in alternating electric current induction motors." D. L. Lindquist. March 9th.

5,062. "Improvements in cord-controlled switches for electrical purposes." A. T. M. Thomson and The Thomson-Davis Telephone System, Limited. March 9th.

5,063. "Improvements in accumulators for secondary batteries." T. T. A. Hansen and C. C. F. F. Petersen. March 9th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

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8,358. "Improvements in electric storage or secondary batteries." J. T. Nisbett and M. Sutherland. Dated April 21st, 1899. The plates or electrodes consist each of a thin metal plate or grid with flanged edges projecting on one or both sides of the plate and serving to hold the active material in place. Porous slabs of earthenware or the like aid in keeping the active material in place, and serve also as separators. At the ends of the battery the plates are replaced by glass plates. Rubber pieces serve to keep the plates apart, and bands hold the whole together. 3 claims.

8,398. "Improvements in electricity meters." C. D. Abel. (Societe Anonyme Continentale Pour la Fabrication des Compteurs a Gaz et Autres Appareils.) Dated April 21st, 1899. Motor meters. Thick wire field coils influence a fine-wire armature which is carried by a spindle geared to a counter and retarded by a copper ring carried by light arms on the spindle moving in the fields of permanent magnets. These are supported adjustably by a nut screwing on a fixed upright tube, a scale marked on the ring facilitating the adjustment. The spindle has pointed ends supported in jewelled bearings which slide in tubes and are acted on by springs adjustable by screws; when the meter is to be moved the tube is loosened and pressed down until it and the tube engage conical projections on the spindle, and the tube is then again clamped, the spindle being thus firmly held and the bearings protected. 4 claims.

8,468. "Improvements in arc lamps." E. W. Bohle, H. Bohle, and J. A. Phillips. Dated April 22nd, 1899. Arc lamps. The carbon holders are carried by rods provided with guide wheels run on four rods and connected by a cord passed over a wheel, which carries ratchet teeth. The upper holder is attached to the core of a shunt solenoid; the lower holder is adjustably weighted to be heavier than the upper one, the difference in weight being balanced by the pull of the solenoid in the ordinary working of the lamp. The solenoid may be ironclad. A pawl is supported by a light spring on a lever pivoted on the lamp frame. When the arc is first struck a tooth engages the pawl and turns the lever in opposition to a spring so that another part of the lever grips the rim of the wheel. The length of the arc depends on the extent of movement of the lever from an adjustable stop. In a modification, the pawl is carried by a vertical spring-pressed slider, the parts being dispensed with. In another modification, the carbon holders are connected by two cords, and controlled by two ratchets and solenoids of like construction. 4 claims.

8,483. "Improvements in electrical signalling apparatus." E. Lavens and E. J. Lavens. Dated April 22nd, 1899. Relates to electric lamp and bell signalling apparatus of the kind described in Specification No. 3,209, A.D. 1898, for use on shipboard as an engine room telegraph. In the present invention, the time and duration of the signals transmitted are recorded by means of the apparatus. The drum is driven by clockwork, so that it revolves once in 24 hours, and is surrounded by a strip of paper, which is graduated lengthwise by parallel lines corresponding with the different signals, and is graduated crosswise by lines corresponding with the hours and fractions of hours. The signals are recorded by star wheels mounted on levers and adapted to be operated by corresponding rods from the armatures of the signal-controlling electro-magnets. When a signal is transmitted, the corresponding star wheel marks a series of dots on the line allotted to that particular signal, and over a length depending on the time during which the signal is maintained. For indicating the number and direction of the revolutions of the engine and their direction, the handle, which works the valve gear, is provided with contacts adapted to complete a circuit through one or other of two electric lamps, one of which indicates "ahead" and the other "astern." The operative lamp circuit is made and broken once during each revolution of the engines, from any convenient reciprocating part, either by means of metallic contacts, or preferably by moving the core of a solenoid controlling the circuits. Instead of, or in addition to, the lamps, counters for "ahead" and "astern" working may be employed, the counters being actuated by currents transmitted in the same way as for the lamps. 2 claims.

8,497. "Improvements in bulbs for electric incandescence lamps." C. Bartenstein. Dated April 22nd, 1899. Incandescent lamps.—Bulbs are moulded with circular corrugations, in planes at right angles to the length of the filaments and of any desired form in section, to diffuse the light. 1 claim.

8,522. "Improvements in or relating to storage batteries." R. Welford. Dated April 24th, 1899. Relates to the plates or electrodes. The essential feature of the invention consists in the use of pendant lengths of wire, which are either coated with paste or are formed after Planté's method. The wire, which may be of lead, is coiled into a helix, and when the electrodes are formed after Planté's method, they remain in this form, and one helix may be placed inside another helix, but when the electrodes are formed in Faure's method, the helix is preferably somewhat drawn out. The wires may be used in combination with a rubber plate formed with corrugations of any shape, and one wire hangs down in each corrugation, and the latter is then filled with active material. The wire may pass through a hole into the next corrugation so that the active material in opposite corrugations forms one mass. The wire may be bent into other shapes than helices. 5 claims.

8,641. "Improvements in apparatus for rectifying alternating electric currents." The British Thomson-Houston Co., Ltd. (E. Thomson.) Dated April 25th, 1899. In order to reduce sparking to a minimum, the brushes are so placed in relation to the commutator that contact is broken at a certain period of the phase, and means are provided for automatically varying the position of the brushes in accordance with variations in the load. In an arrangement adapted for rectifying a two-phase current supplied from a generator through a transformer with relatively movable coils adapted to give a constant current. The secondaries are suspended from the levers and adjust the position of the brushes of the rectifier through the intermediate gearing, which may be links and levers or spur, or other gearing. Instead of the coils of the transformers controlling the brushes, additional coils suitably connected may be mounted on one shaft, with the brushes independently controlled, and switches may be provided for throwing in a reserve set of machines and cutting out the active machines simultaneously. 19 claims.

8,672. "Improvements in and relating to electric motor carriages or vehicles." A. Lewis. Dated April 25th, 1899. Relates chiefly to the suspension of the batteries, to the independent operation of the driving wheels, to the control and reversal of motors, and to the warming of the steering handle. The frame of the under-carriage is composed of tubes connected by loose joints which permit relative movement in passing over uneven ground. The batteries are mounted independently of the body of the vehicle on a tray supported in a casing by springs on hangers depending from the wheel frame. This arrangement enables different carriage bodies to be used with the same under-carriage. The motors are suspended at the back by eyes embracing the rear axle, and at the front by a lug held between springs above and below carried by a hanger. The motor has two separate armatures, each driving one of the hollow axles of the driving wheels independently. In another construction there are within the field shell or casing two sets of pole-pieces between which rotate the independent armatures. The motors are preferably wound in series and the two parts connected in parallel, thus allowing the use of one half in case the other should burn out. The starting, stopping, reversing and regulation of speed and power are effected by a rotary cylindrical series-parallel controller, which is operated by electro-magnetic and ratchet gear by means of push buttons conveniently disposed in a certain handle. 5 claims.

8,693. "Improvements in converting transformers." C. D. Abel. (La Societe Anonyme pour la Transmission de la Force par l'Electricite.) Dated April 25th, 1899. The apparatus comprises a transformer of special construction and a commutator having revolving brushes and collectors. A transformer for converting alternating into direct current is fitted (1) with primary circuits excited by alternating electromotive forces differing in phase by $\frac{1}{n}$ of the period, and (2) with κ secondary circuits which should carry 2 κ alternating electromotive forces differing in phrase $\frac{1}{\kappa}$. The collector has 2 κ synchronous segments connected to the secondary circuits. The number of cores and the number of turns in the various windings are founded upon the results of a mathematical investigation, described in the specification, the numbers marked in the cores being the cross-sections in square centimetres. The cores are arranged in two series, one above the other, there being 72 in all. The secondary circuits preferably consist of copper bands, there being two secondary windings on each core. The rotary commutator is placed between the two groups of cores. It has 48 contact rings connected to the terminals, and is formed preferably in two parts driven by synchronous motors. For converting continuous into alternating currents, one of the motors is a direct current motor, and the continuous current is supplied to the system through the brushes on the collector. 2 claims.

8,726. "Improvements in switches for electrical purposes." A. Watson. Dated April 26th, 1899. Switches particularly adapted for connecting up one or other of a pair of lamps. In one form, an oscillating block carries a contact adapted to connect the terminal with the contact. The block is slotted or bifurcated to receive the end of the operating tumbler handle. In a modified form, the handle is replaced by a turn-button and the block by an eccentrically-mounted block. In a two-way switch the block carries spring contacts adapted to engage with terminals. For single-pole switches, one of the contacts, or a pair of contacts, is dispensed with. 4 claims.

8,775. "Improvements in and relating to electric incandescent gas lighting." M. Lachman. Dated April 26th, 1899. A cap is stamped from sheet metal and a disc from it, leaving a rounded flange to stiffen the cap against lateral pressure. Pins to engage a bayonet-joint holder are formed from the metal of the cap, either by pressing it out into loops between pairs or slits, or by pressing out tongues. Soft sheet-steel is preferably used, and the caps are plated with copper or other metal to suit the fittings and prevent rusting. 5 claims.

8,834. "Improvements in and relating to Rontgen Ray apparatus." J. M. Davidson, M.B., C.M. Dated April 28th, 1899. Relates to apparatus for producing stereoscopic Rontgen pictures. The body to be illuminated is placed between the phosphorescent screen and the two focus tubes which are excited alternately by two induction coils. The eyes of the observer are placed opposite two openings, which are opened alternately by a shutter or shutters actuated from the same axis as the interrupters of the coils. A pseudo-stereoscopic effect is obtained by changing the difference of phrase between the interrupters of the coils and the shutters of the openings. The interrupters comprise two metallic sectors mounted, in opposite phase, on the rotating axis. The sectors dip alternately in layers of mercury at the bottom of the boxes the mercury being in connection with the terminals. The intercharging switch consists of four arms which rock on the axis, on which are four terminals permanently connected to the interrupters by wires. By rocking the axis the ends of the arms dip into mercury cups on one side or the other of the axis. These mercury cups are connected diagonally by wires in the insulating baseboard. It is evident that, by rocking the axis to one side or the other, the interrupter which controls the action of a given coil can be changed to the other coil. 4 claims.

8,957. "Improvements in or connected with connecting devices for electric conductors." H. Reason and The Mutual Electric Trust, Limited. Dated April 28th 1899. Relates to connections for the separate ends of concentric cables when these are attached to fuses in separate boxes. A branch is secured by a screw or other collar to the outer conductor and leads to one fuse box, a protective sleeve entering both chalice and fuse box. An inner conductor is led direct to its fuse box, and is surrounded by a sleeve. The chalice is afterwards filled with insulating material. 4 claims.